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ABSTRACT

Practical information is supplied that can be directly applied to early childhood projects and used for staff inservice in data collection procedures. This information assists in documenting the overall effectiveness of an approach and aids in making the frequent educational decisions to ensure the child is benefiting from instruction. Separate chapters discuss: (1) starting up with data-based programs (by Eugene Edgar); (2) a simplified method of data collection for inappropriate behaviors (by H.D. "Bud" Fredericks); (3) collecting data on social skills (by Karen J. Morris); (4) assessment and modification of cognitive processes of handicapped children (by William A. Bricker and others; (5) measuring motor behavior (by Philippa H. Campbell and others); (6) developing language through communicative interaction (by Linda L. Lynch and Johanna L. Lewis); (7) measuring self-help skills (by William G. Moore); and (8) data-based program change decisions (by Owen R. White and Norris G. Haring). (PN)

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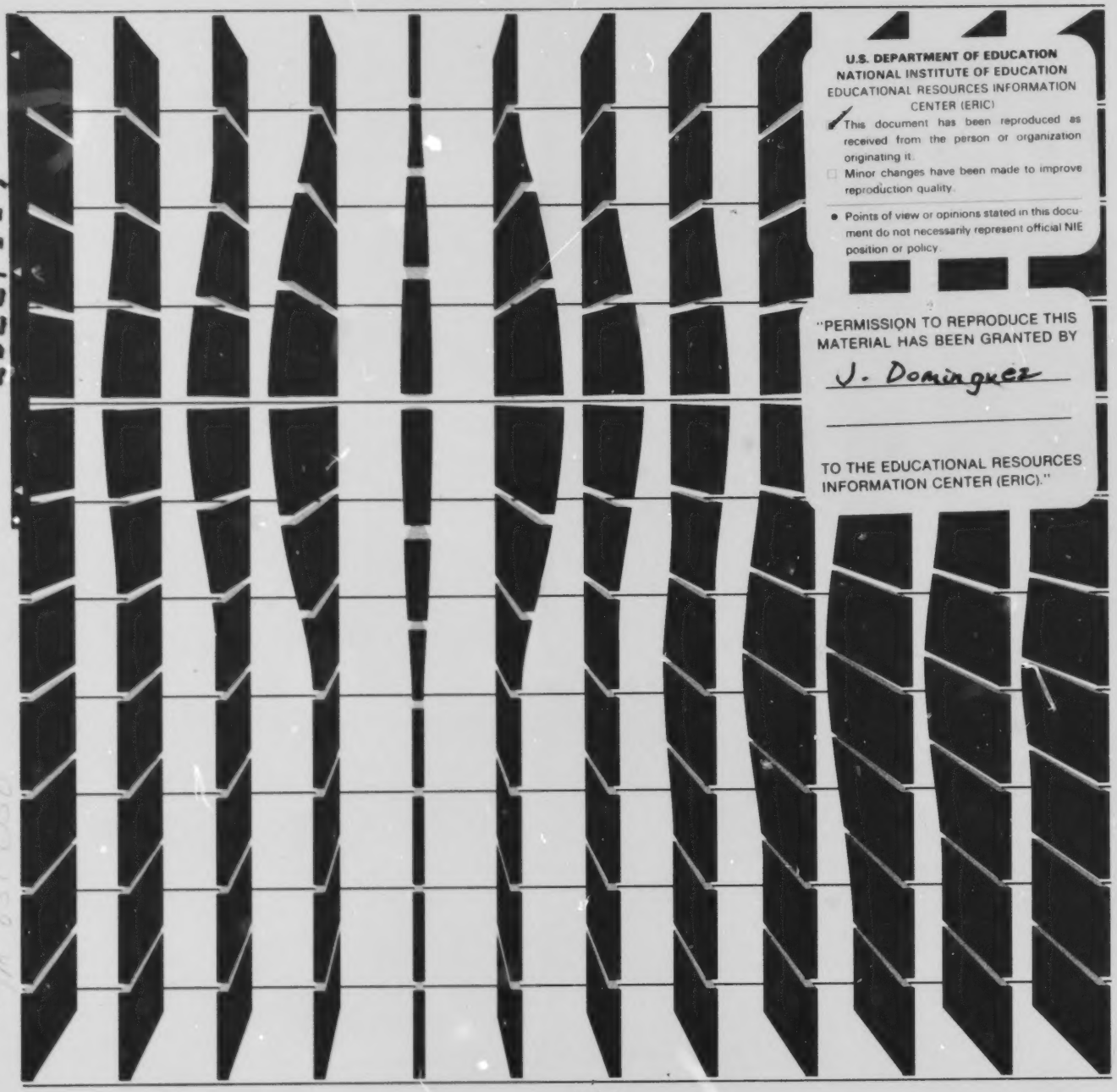

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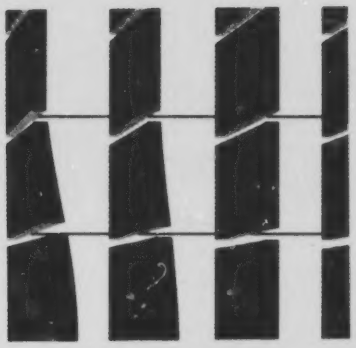

Ongoing Data Collection for Measuring Child Progress

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DATA COLLECTION: OVERVIEW AND RATIONALE

Victor L. Baldwin

This introduction is presented in an effort to entice you to read further into this document. We would like to convince you (if necessary) of the importance and ease with which an adequate data collection system can be developed. During our many opportunities to interact with the directors and staff members of hundreds of Early Childhood projects and to discuss with them what they felt were their major needs for technical assistance, it became abundantly clear that issues surrounding data collection were a common high priority. This interest, coupled with the federal, state and local requirements for operating an Early Childhood program that is responsible for demonstrating effective and innovative methods, re-emphasizes the need for commitment to careful documentation.

As an early childhood program director or staff member you no doubt do not feel your project was funded for the sole purpose of providing direct services to a specified number of handicapped children. Your total responsiblity is much broader. That you have at this time secured funding for providing services to young handicapped children indicates that a funding source has been convinced of your ability to provide beneficial intervention services to these children. Soon you will both want and be required to demonstrate the effectiveness of your procedures. Therefore, one important activity throughout the program will be gathering sufficient data to indicate both the growth of individual children and the overall benefit of the program to the children served. Your ability to do so will not only strengthen support for your program but for early intervention for all handicapped children.

You can focus on a variety of indicators of success, such as evidence of the large number of children that you can serve for small amounts of money or cost effectiveness. However, you will inevitably be asked to define "serve?" The answer to this question will lead to a "bottom line" where you will eventually have to call upon student performance data in order to document and interpret the impact of your intervention procedures on the education of handicapped children. There are many other indicators, but the effect on children is "Where it's at."

Every time the discussion of data collection comes up, anxiety levels begin to rise. I think it is because we have all had a difficult time measuring the impact of our programs, particularly when we are dealing with very young or severely impaired children. It is also very easy for an educational researcher or an experimental psychologist to point out to us how we have violated basic laws of research design and how we can't possibly make statements of cause and effect.

In these chapters we are not going to attempt to arm you with the necessary information to adhere to the rigors of research design, but we do intend to supply you with practical information that can be applied directly to your project and that can be used for staff inservice in data collection procedures. This information will assist you not only in documenting the overall effectiveness of your approach but aid you in making the frequent educational decisions you must make to insure the child is benefiting the most from your instruction.

I would like to pose the argument that you are already collecting more information than would typically be required in a research endeavor. If there were a way to document the number of observations that were made by teachers and other personnel on the children with whom they work and the number of decisions that subsequently were made to determine what to

do next, it would be overwhelming. The process of observing a situation, making a decision and acting on that information is something that we do in every facet of our lives every day. I will be, nevertheless, the first to agree that this process is not always done systematically or most efficiently, and therefore we offer in this document suggestions on organizing observations, recording them consistently and using them for decision making.

Over the years I have visited many projects and have observed that the most frequent strategy for measuring the impact of a program is the utilization of pre and posttests. These tests are a reasonable strategy given that you have an adequate instrument and are only interested in measuring progress over a long period of time. For the day-to-day decisions that must be made regarding how best to teach the students, however, the pre and posttests just don't provide the necessary information. The other extreme would be a procedure whereby every single response made by the students was monitored, recorded and used for decision making. This cumbersome procedure is also unlikely to be effective in light of the huge number of resources that would be required to utilize such an approach. Therefore, past experience would suggest that optimum data collection strategy lies somewhere between these two extremes.

Most researchers have identified what they wish to teach to an individual student and most things to be taught can be analyzed in terms of their subparts. In fact, most teaching occurs as a result of getting the student to approximate the terminal behavior; through practice, he or she becomes more accurate. It is this progress through the various approximations of achieving mastery of the task that needs to be documented.

As the student gets closer and closer to mastery, he or she is in fact gaining new behaviors. Many times the steps are quite small, but they are discrete new behaviors that were not there when instruction began. If this progress is being monitored, it is possible to make effective decisions. When the tasks are being achieved with ease by the student, the teacher can feel free to jump ahead one or two levels of difficulty to see if the education process can be accelerated. If the student is not progressing on the task, it must be assumed that the instruction is inadequate and therefore needs to be altered. By using such a monitoring system it is possible to avoid two major pitfalls of instructon. The first pitfall is leaving the student on the same task that has been mastered to the point of being boring; the second is relentlessly keeping the student on the same task that has continually produced failure. This constant failure frequently causes the student to become extremely frustrated and to try to avoid the teaching situation altogether.

Several of the chapters in this document will recommend strategies for ongoing data collection that can be incorporated into everyday teaching and that do not impair the quality of teaching. A major criticism of the continuous evaluation approach has been voiced by teachers and generally sounds like this: "If I have to gather all those data, I won't have time to teach". This is a legitimate complaint, and such a data system should not be acceptable. There is, however, a variety of extremely simple procedures which require no more than marking an X or an O on a piece of paper while the student is performing a task or just after the student has completed a task, that indicate whether or not his or her performance was satisfactory on that particular trial. This will of course require you to define what satisfactory means to you and your staff and therefore to set criterion levels of acceptable performance. You should probably do this anyway because if you don't, you risk having different standards on different days or individual standards among the various people who work with the same student at different times. I think you would personally find this frustrating if you were a student under such an arbitrary system. I can imagine how you would react if the speed limits on your favorite highway were not posted and left to the whims or impressions of the various officers who patrolled that area.

As you are well aware, we are all responsible for developing a specific plan for each student, called the Individual Education Plan (I.E.P.). In this plan we must state our long range and short range goals and objectives for each student. The I.E.P. requirement lends itself nicely to the establishment of a series of short range objectives that we wish to achieve with each student and a description of the intervention approach we plan to use. If you have progressed this far in the development of your programs for children, it is a short next step to designing a data collection system that will document the achievement of those objectives. By choosing a few (six to eight) objectives to be worked on with each child on a daily basis, it is possible to select some of them to be evaluated on a daily trial by trial basis and others to be probed on a two- to three-day basis. You are going to be teaching these things anyway, so you might as well record some simple observations. By picking two or three things that everybody will record each time they work with a particular student, no one will be overburdened with data collection. The other objectives can be monitored on a less frequent, but consistent, basis. You might want to set aside specific times on certain days that will be used to probe or test to see how the student is progressing on these additional objectives. Reserving specific times for data collection will allow you systematically to determine if progress is being made towards your short term objectives and to make decisions about teaching strategies. Such documentation also becomes an excellent vehicle for staff discussions in that common data or observations provide consistency across personnel and a common basis for discussing an individual student's progress. Finally, ongoing data collection will allow you to make statements and decisions regarding the effectiveness of the educational intervention for both individual children and the overall program.

So far only the need for student performance data and the measure of your program's impact have been discussed. These were highlighted because they seemed to produce the most difficulty for programs and because I personally feel that every professional has a moral and ethical responsibility to make the best possible decisions when those decisions affect the life of another human being. You may have other commitments to data collection procedures in your project outside of the realm of student performance impact data. Some of your overall program objectives may be expressed in terms of establishing activities or products. These are also important to monitor because they can be used as a gauge by which you judge the evolution and development of your program according to the timelines you projected would be necessary. These kinds of evaluations, as to whether or not a goal is in place and on schedule, are much easier to make and are frequently utilized by successful programs.

There is a danger, however, in collecting too much information. Besides the obvious reason of overtaking personnel resources, you will also be required, sooner or later, to synthesize these data and present them to your immediate superiors and/or officials at the funding source. For example, the continual student performance data discussed earlier has its maximum utilization at the classroom level. These data make possible efficient, timely decisions about the education process. This volume of data, however, will have little meaning to a supervisor, superintendent or funding officer, for that person is much more interested in a synthesis of the progress being made over a longer period of time--three months to six months or a year.

One area of data collection and documentation will become vividly important to you if you should find yourself engaged in training others to provide services. This occurs most frequently with the addition of new staff members, but it is also a service offered by many successful programs. In essence, this means you must now take procedures that you have demonstrated to be effective and teach somebody else to do them. The more refined and developed your procedures that describe the intricacies of your project, the easier it will be to translate those procedures to another professional. Such refined procedures will assist you in deciding what

experiences trainees should be exposed to while learning your system. In refining your programs you must consider which elements of your procedures can be written so they stand alone and don't require a great deal of instruction time and what levels of performance a trainee must achieve so that you will feel comfortable he or she has in fact learned your process and can therefore implement it in his or her setting. Each of these questions is critical if you are going to develop a standard by which you will measure the effectiveness of your training.

When considering the replication or demonstration of successful practices within your program there are a series of questions that must be answered. For example, which of the components of your program are you most interested in seeing replicated? How much training will be required to teach somebody these components? How will you know when they are learned, and how will you measure whether or not replication (or use) has occurred successfully? You may not be interested in answering all of the questions, but to answer any of them successfully will depend on how adequately you have collected data before, during and following training. The prime time to develop those procedures is before you begin your training activities outside of your project. You have the opportunity to experiment with strategies and approaches with your own staff before you enter replication activities. You need to know how a teacher must function to be successful in your project. By the same token, you need to have a monitoring system that indicates when the acceptable performance is being violated. If you intend your curriculum to be used in a particular way, then you must develop a simple observation system that indicates whether or not a trainee is following the correct procedures. If there is a set way to administer your screening device, then an observation system needs to be used that will indicate whether or not the procedures are being followed, and if not, when the mistakes are being made. Using such an approach provides an excellent vehicle to give feedback to the trainees. These measures used internally to determine whether or not staff performances are meeting your standards can then be easily employed for training new staff, maintaining staff performance, training outside personnel and evaluating the success of your training. They are easily transported to other sites to be used by other program administrators.

There is one final step in gathering data regarding the impact of your training. It is very important to be able to document that in fact the procedures that you have developed are being utilized by somebody else as a result of your training. However, the final proof of effectiveness remains at the level of impact on handicapped students. If you have been able to demonstrate in your project that you can have a significant impact on the learning of handicapped students and if you can also show that the people you have trained can make similar impact, you can rest assured that you are now an exemplary project. This last source of data unfortunately may not be available to you during your initial years of operation. It is therefore important that you are able to document the degree of replication you have been able to achieve by measuring trainee performance and subsequently to have plans in place also to measure the impact on students after trainees have had time to incorporate your procedures. If this final evaluation step is not your responsibility as the training agency, it is still importantthat you be able toprovide trainees with the skills and techniques for measuring the impact of the training they have received on childrens' learning. This final evaluation phase is an important and often neglected step that is needed to insure quality delivery of services to children.

All of these issues being raised are for the sole purpose of re-emphasizing for you the need for focused attention on data collection procedures. It is extremely important that you be sensitive to the areas of concern raised here and be able to incorporate adequate data systems into your project without overdrawing your resources to the point you can't be effective in delivering an educational program. The issues are serious, but the solutions to documentation

are often not as complex as they may seem in the beginning. The information contained in this document should give you ideas and suggestions as to how you can collect various types of data on the components of your project.

In summary, I would like to re-emphasize that you are not conducting a research project. However, you should keep in mind that the major purpose of data collection is for decision making. Once you have agreed what it is you want to do and how you propose to accomplish it, then it becomes necessary to incorporate data collection procedures as an integral part of your project. The procedures should not be so complex as to impair the quality of your education program; in fact, they should make your task easier. It is not important on which philosophical basis your poject is working, because the concept of data collection is not the sole property of any single approach to education. If you approach the task from the point of view that you know your strategy is a good way to work with handicapped children, then you are simply left with a task of determining how you document what you already know is effective in order to assist you in transmitting that information to others. Taken from this point of view you might actually find that the design of data collection procedures can be fun and result in an efficient way for you to tell other professionals what you knew was right all along.

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STARTING UP WITH DATA BASED PROGRAMS

Eugene Edgar

Educational technology has developed to the point where there is considerable agreement about the process one should follow whenever attempting to teach a skill to another individual. This process contains the following sequence:

- assess the current skill level and learning mode of the individual(s) to be taught;
- set appropriate goals and instructional objectives;
- develop precise instructional plans for each objective; and
- implement the plan, collect ongoing performance data and move on to the next objective or revise the instruction, as indicated by the performance data (see White & Haring, 1980 for more detail).

These rather simple steps provide teachers a framework in which to operate. The art of teaching is the ability to relate to children and to match instructional procedures to each child's learning characteristics. The technology of teaching involves being precise, being aware of exactly what the teacher is doing (the nature of instruction) and being aware of exactly how the child is doing (the result of instruction). In special education, actual instructional procedures depend on the objective, the age of the child, the child's particular disability, the instructonal setting, the biases of the teacher, as well as a number of other variables. However, the process of instruction remains constant. There are no short cuts. Teaching requires time and energy; planning is absolutely crucial; and the teacher must be able to answer the question, "Are my children learning?"

The focus of this chapter is on the final step in the instructional process: ongoing data collection of child performance. This step is probably most resisted by teachers, primarily with the complaint, "If I do all these things I don't have time to teach." However, if a teacher can't answer the questions: "Is my instructional program effective? Are the children learning? Have they mastered the desired skill?" then he or she isn't teaching. The answers to these questions enable the teacher to alter programs appropriately, to move on to new instructional objectives or to continue with current instructional programming. In other words, these data allow the teacher to maintain optimal instructional practices for each child.

Assuming the teacher has progressed through the initial steps of the instructional sequence, collecting child performance data follows a simple set of procedures. First, the skill to be taught has been specified. Then, when the teacher has determined which of the target skills are already in the child's repertoire, instructional plans are developed for the skill to be taught. During implementation of the instructional plan, the teacher counts the child's responses and, finally, uses these data to make instructional decisions.

How to Measure Child Performance

After the teacher using the instructional assessment has determined which skills to teach (see Howell, Kaplan, & O'Connell, 1979), he or she must develop procedures for measuring child performance. Three basic factors should be considered in establishing a measurement system:

the desired behavior, when and where it should occur, and how it should be counted. The fundamental rule for all instructonal data collection is: Design the system to help the teacher make instructional decisions.

Specifying the Behavior to be Counted

It is important to specify exactly what the child and teacher are to do. Accurate data collection, and therefore an accurate measure of progress, is impossible without a clear description of the behavior of the teacher and child during a trial and the criteria for success.

Trials. For data to be meaningful, each datum point must represent a specific single trial. A full description of the trial, including teacher and child behavior, must be developed. The record of the child's performance must relate to this description. The description may read, "Given the command, 'Pinch the button,' and the teacher model, the child will pinch the button with tip of forefinger and thumb within 5 seconds of command." This description details one trial. The data tell us whether the child did or did not perform the task as described under the conditions set forth.

Criteria for Success. Before any data are collected, the teacher should determine the desired child behavior. In most cases, this determination will yield a clear statement of what the child will do (an observable action), under what conditions and in what period of time. Success is most often recorded by making simple yes-no statements. For example, consider the behavior stated as follows: "Given a cue, match the shapes, the child will match square to square, circle to circle, triangle to triangle, within 20 seconds." If the child does not meet every one of these criteria, or if the teacher allows any behavior other than that which was specified (by physically prompting the child, correcting an error, repeating the instructions, or allowing a longer latency of child response), an error score must be recorded. If errors persist, the teaching strategy must be altered. In some cases alteration may mean changing the criteria for success (i.e. increasing time allowed, tolerating misses, decreasing the amount to cover, etc.). However, for each teaching trail there must be specific criteria for successful behavior.

Function of the Desired Behavior

This issue deals with two questions: "Can the child perform the skill?" and "Does the child perform the skill?" The first question refers to the child's ability to perform the skill in response to instructions in an instructonal setting. The second question addresses the child's performance of a skill in a natural setting after instruction.

Teaching the behavior in an instructional setting. (Can the child perform the skill?) If the child cannot perform a given skill the teacher will want to develop an instructonal program to teach that skill. First, the skill is task analyzed or a curriculum focusing on that skill is used. Care should be taken not to break the task into steps too small (Liberty & Wilcox, 1981). An instructional sequence is then developed which consists of small sequential learning steps. For each step, an instructional program is developed. This program specifies what the teacher will do to elicit the desired behavior and what the consequences to the child's response will be. Finally, the teacher determines how the child's responses will be measured in order to ascertain when the child has mastered the skill.

Generalizing the skill to the natural setting. (Does the child perform the skill?) After a child is able to perform a skill consistently in an instructional setting, the child must learn to use the skill in a functional manner in the natural setting. The teacher will want to develop a system for collecting data on child performance in functional circumstances. For example, if counting objects has been mastered in the instructional setting, the teacher will want the observer to see if the child will count plates at snack time. Obviously, the system for recording the data will vary depending on the target behavior.

Counting the Behavior

Criterion-referenced statements. Criterion-referenced statements (i.e., yes-no statements) are most commonly used during instructional programming. In this instance, after task analysis and instructional sequencing, the teacher simply notes if the child has made a correct response for each instructional trial. The teacher records the number of correct responses per teaching session or the percentage of correct responses. In either case, these data allow the teacher, over time, to determine if the child is making progress. Table 1 illustrates one method of recording behavior in this manner.

Table 1
Criterion-Referenced Statements

Matching

	Number Correct				
	Day 1	Day 2	Day 3	Day 4	Day 5
Given the cue, "match the shapes" child matches square to square, circle to circle, triangle to triangle within 20 seconds on 2 consecutive days.	II	II	III	III	

Duration data. Other data that can be collected are duration data--they indicate how long a child performs a given task. For example, when teaching head control to a child, the teacher may want to time how long the child performs a skill. In this instance, the criterion might be: child holds head off mat for 60 seconds. For each trial, the teacher would time the response and record the length of time the child held the head off the mat. In this way, the teacher can see over several days an increase in the amount of time the child performed the task and, thus, the child's progress. Simple yes-no data would have given no indication of response in this situation, therefore, duration data were more suitable. An example of record-keeping on duration data is contained in Table 2.

Rate or frequency data. For some behaviors, rate data are appropriate. Rate data refer to how many times a child performs a specific behavior in a given time period. For example, a child might feed him or herself with a spoon (scoop, spoon to mouth, food in mouth, spoon out of mouth, chew and swallow, scoop) at an extremely slow rate--once every two minutes. In this case, the teacher might want to collect rate data--the total number of complete cyles that

Table 2
Duration Measures

Head Control

	Number of Seconds Head Held off Floor				
	Day 1	Day 2	Day 3	Day 4	Day 5
While in prone position on mat, with teacher prompts using rattle and mirrors, the child will maintain head off mat for at least 60 seconds. Three trials per day.	28/30/25	25/20/22	35/30/25	40/35/35	36/34/38

occur over a specified period of time. Again, over time, these data will allow the teacher to note the type of progress a child is making and to make program decisions based on the data. Table 3 shows one method of collecting rate data.

Table 3
Rate Measures

Dressing

	Buttons Per Minute				
	Day 1	Day 2	Day 3	Day 4	Day 5
On teacher command, child will button 3 buttons on his coat within 1 minute, on 2 consecutive days.	2	3	2	3	3

Frequency data give an idea of how often a behavior is occurring. This kind of data differs from rate and duration data in that speed of performance takes a back seat to number of performances. Frequency data are useful for recording, for example, the number of times a child shares a toy with another child. Frequency data can be recorded as shown in Table 4.

Table 4
Frequency Counts

Toy Sharing

	Number of Times Toy Shared				
	Day 1	Day 2	Day 3	Day 4	Day 5
In a free play situation the child will initiate toy sharing with another child.	1111 11	111	1111 11	1111 111	1111 1111

Error analysis. In some instances the teacher may want to keep data on the types of errors a child is making in addition to the correct responses. For instance, in toilet training, the teacher could record the number of "hits" as well as the number of "misses." This type of error data can aid the teacher in making alterations in the instructional program (Table 5).

Instructional Planning Based on Data

Once the data are collected, they must be organized in a fashion which indicates whether or not there has been progress. On the basis of the "story" told by the data, the teacher will decide what the next step will be: proceed to a new instructional objective, adjust criteria to ensure success or attempt to generalize a behavior to the natural setting.

Displaying Data

After baseline and child-performance data are collected, the teacher needs to display or organize these data visually in order to make instructional decisions. Such organization can be accomplished in a variety of ways, depending on the type of data collected, the available teacher time and the data decision rules being used.

The easiest method is simply to record the raw data and indicate if criterion has been reached, as shown in Table 6. Or the data may be transformed, for example, to percentages, as shown in Table 7. Either the raw or the converted data can be placed on the child's worksheet, on a separate piece of paper, on a data sheet, or a graph such as the one shown in Figure 1.

Table 5
Error Analysis

	Day			Day			Day		
	Indicate and does	Indicate and does not	Miss	Indicate and does	Indicate and does not	Miss	Indicate and does	Indicate and does not	Miss
Child will indicate his need to urinate and urinate 3 days no wet pants, no false alarms.	11	1	1	1	11	11	11		1

Decision Making

The entire reason for collecting data is to determine whether: (1) the child is ready to move on to the next task, (2) the child is learning but is not yet ready to move on, or (3) the child is not learning. In order to use child performance data meaningfully, the teacher must devise procedures to answer the above questions. For a very detailed discussion on data decision rules, see Making Daily Classroom Decisions (White, Note 1).

Table 6
Raw Data

Face Washing

	Number Correct				
	Day 1	Day 2	Day 3	Day 4	Day 5
On teacher command and physical prompt, child touches wet washcloth to face, within 5 seconds, 5 of 5 times, 2 consecutive days.	II	III	IIII	IIII	

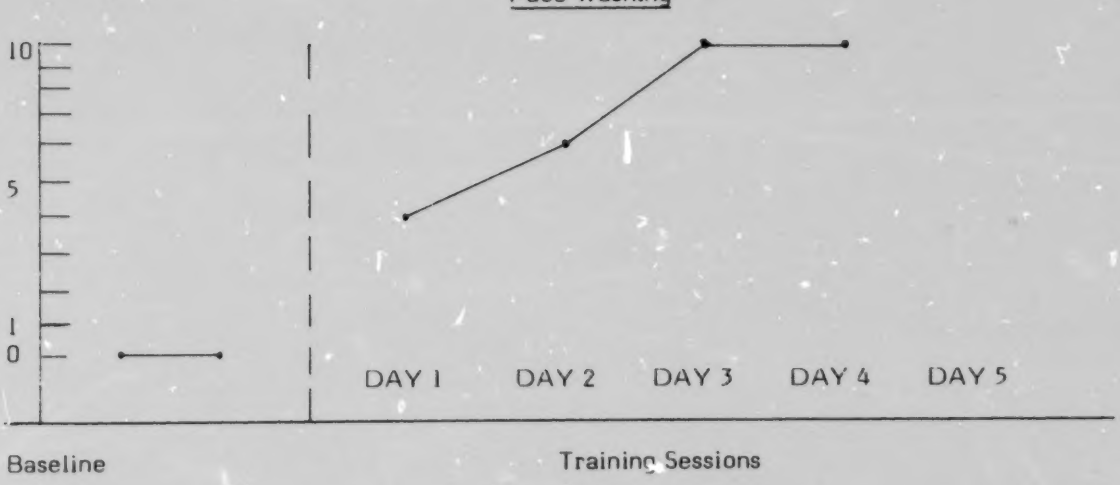
Table 7
Percentages

Face Washing

	Percent Correct				
	Day 1	Day 2	Day 3	Day 4	Day 5
On teacher command and physical prompt, child touches wet washcloth to face, within 5 seconds, 5 of 5 times, 2 consecutive days.	40%	60%	100%	100%	

Determining mastery. In most cases, mastery criteria are stated in correct responses over time--for example, five correct on five trials over three consecutive days or 70% correct on two consecutive days. The importance of clearly stating when mastery has occurred cannot be overemphasized. In many situations, simply because there is no clear definition of mastery, teachers keep children working on a skill they have already mastered. This obviously results in a delay in mastering additional skills. One must clearly state the criteria for mastery and, as soon as they are achieved, CELEBRATE and move on.

Figure 1
Percentage Graph



Determining ineffectiveness of instructional program. Because children learn differently and various skills take more time to learn, it is very important to decide when an instructional program has been unsuccessful. Generally, there should be some improvement over three or four days of instruction. If instruction took place and the child did not appear to be sick or have other problems, yet no progress was noted, changes in the program should be made.

Adjusting a program for success. What do you do if learning is not occurring? Certainly this is a topic for another manuscript, but generally there are seven things a teacher can do:

1) slide back and make the task easier;
2) alter teacher directions, demonstrations or prompts;
3) alter the instructional materials;
4) alter the consequences to the child's responses;
5) determine whether the child lacks prerequisite skills for the task;
6) analyze errors to try to determine error patterns; or
7) stop teaching the skill and choose a new skill; in other words, punt.

Generally, if after the first six steps have been tried learning still does not occur, then step seven should be tried. Continual failure only breeds frustration for the child and the teacher.

In summary, data collection during instructional programming allows the teacher to determine if the child is learning the desired skill. In order to collect meaningful data the teacher must determine what type of data to collect (frequency, percentage, rate). Additionally, the teacher must make sure that each individual data point represents a single trial. For each behavior there must be clear criteria for success. After gathering data, the teacher then displays or organizes it so that one of the following instructional decisions can be made: 1) the child has learned the skill--move on; 2) the child is learning but has not yet reached criteria allowing him or her to move on--keep on using the instructional procedures; 3) the child is not learning--make a change in the instructional program.

Functional Use Data (Generalization)

After the child has demonstrated that he or she can perform a certain behavior, (e.g. tie shoes), the next question to ask is, "Does the child consistently and appropriately do the behavior?" This is an extremely important concept. Teaching children to perform skills in instructional settings is not enough--we must make sure the children then use these skills, in a functional manner, in natural settings. Technically, this is called transfer, generalization or maintenance. The basic question is, "Does the child function appropriately, at the correct time when given ample opportunity?" Obviously, if the answer is no, an instructional program must be developed to help the child perform appropriately. (See Stokes and Baer (1977) for a detailed discussion on generalization programming techniques.)

Clearly, for skills to be functional, the child must perform them in a variety of settings, under varying circumstances, and for a large number of adults. Keeping data on the generalization of skills is as important as keeping data during the instructional phase.

As with data collection during the instructional phase, the teacher should determine how to collect these data (usually yes/no and frequency), generate a statement of success (when the skill is part of the child's functional repertoire) and decide when progress is satisfactory. If progress is not satisfactory (i.e., if the child is not demonstrating the skill in natural settings), there are various techniques that can be tried to achieve the desired responses. The first tactic is to create opportunities for the child to use the skill in a functional manner. Far too often teachers teach skills and then never create opportunities for the child to use them. Another technique is cueing or prompting the behavior (e.g., "Does anyone have to use the bathroom?" "What do we do before we eat?"). In some cases the child needs to be reinforced specifically for performing the skill. What is hoped, of course, is that the skills taught are behaviors which will become self-reinforcing.

Data collection for this purpose may be very simple or quite complex. A record of the child's performance of the behavior when appropriate is often adequate. However, teachers should be aware of factors which affect generalization.

Factors Influencing Generalization

Prompts. Prompts for some behaviors are part of the natural setting. For example, matching shapes, lining up and washing hands usually occur after a prompt from an adult. Other behaviors, such as talking to peers or going to the bathroom, should occur without prompts. As teachers collect data on functional use, they should decide whether verbal prompts are needed or not.

Adults. Some children will perform a specific behavior only for certain adults. For example, one child would tie his shoes whenever the aide (who taught him the task) requested. For anyone else, the child simply would not perform. In this case a program had to be developed to get the child to perform for any adult who said, "Jerry, tie your shoes." In all cases, data should be collected on how the child responds to different adults.

Settings. At times children will perform well in one setting, but not in another. Data should be collected to indicate whether the child performs the skills in all the appropriate settings. This is an especially critical issue in dealing with families. One little girl, Anne, was taught to button her coat, and did so consistently in school. However, parent reports indicated that she refused even to try to button her coat at home. It was necessary to plan a program to ensure that this skill was transferred to the home setting.

How Much Data to Collect

Throughout this paper the topic of how much data to collect has been ignored. In reality, this issue is most often cited as the reason not to collect data: "It takes too much time. When I take data I don't teach. All those charts and dots drive me crazy." It is important to keep in mind that you can collect some of the data all of the time, or all of the data some of the time; but you can't collect all of the data all of the time. It is most important to remember that unused data are worse than no data at all.

In summary, teachers need to devise instructional programs in order to teach their children to perform certain tasks. A great amount of time and effort goes into determining what to teach and how to teach. A great portion of that time and energy is wasted if the teacher does not spend some time in determining whether the child is learning. If a teacher can answer the questions, "How are my children doing?" and "Are my programs working?" for each child--then he or she is probably collecting sufficient data. If the response is, "I'm not sure," then he or she needs to collect more data or collect data differently.

Conclusion

I would like to conclude this paper with a true anecdote. Several years ago I was working with a group of teachers, trying to help them with their teaching skills. As part of my task, I tried to help them become good data collectors. I discussed with them over a period of three months the ideas found in this paper. On a particular day I was chatting with a teacher about the various procedures we had been discussing. When we came to the topic of data collection, he pointed to numerous charts hanging on the walls. The charts were in various colors, mounted on posterboard, and had been developed with great technical skill. I commented on how "fancy" they were and his response was, "I believe in charting." Next, I asked how various children were doing in their programs. After 10 minutes of hemming and hawing he exploded, "Ongoing data collection is dumb! I've spent my evenings making those charts--they're dumb. You university types are all the same--fancy ideas but no concern for teachers. Well, I've seen your type come and seen them go. I'm still here. I'll make your fancy charts but I won't use them. You, too, shall go away."

After many futile attempts to point out the advantages of data collection, and to convince him that there was no need to make fancy charts, I gave up. He was angry, and I was frustrated. Defeated, I turned to leave. On the wall was a torn piece of a brown paper bag with hash marks. With my last gasp of energy I asked, "What's this?"

"Aw," he said, "I have a kid who wets his pants all the time and I'm just trying to keep a record of how many times he does and when he goes to the bathroom."

Falling on my knees, I shouted, "That's data collection!"

His response was, "That?"

Any record that allows you to know if your programs are working reflects appropriate data collection.

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A SIMPLIFIED METHOD OF DATA COLLECTION FOR INAPPROPRIATE BEHAVIORS*

H.D. "Bud" Fredericks

It is generally accepted that building social skills is a major curricular area for preschool children. Yet it is not an area which can be easily standardized. Because the range of social skills usually found among preschool handicapped children is very wide, each child's program must be individualized.

Certainly there are common social skills required in specified environments. The teacher in the schoolroom can prescribe "rules," which are in essence social behaviors that apply to all children, such as clearing toy areas when finished and responding when addressed. Yet the degree of compliance, the verbalization and the type of response varies with each child.

These variations, at least in part, have emerged because of different parental requirements. Most parents want their children to be "well behaved." However, when one examines children in individual homes, the definitions of "well behaved" vary considerably. Some parents demand that children immediately do what they are told; others are not as insistent on the child's compliance. Some parents teach their children to use "please" and "thank you," while others never focus on these amenities. To accommodate this wide range of behavior and training, an individual program for each child in the area of socialization has to be prescribed. The program should be developed by both the parents and the teacher. For some children, the program will be minimal. For other children, those who are exhibiting severe behavior problems, the initial major emphasis of the entire instructional program may be the remediation of inappropriate behaviors.

This paper cannot discuss all the ramifications or techniques for remediation of inappropriate behaviors. What it does propose is to describe the system for data keeping and data management of behavior programs that is used in the Teaching Research Data Based Classroom and that has been implemented in more than 500 other classrooms.

Some programming information will necessarily be included to illustrate how the data system works, but the primary emphasis is on the data and not on the programming. (The graphic presentation is not part of the system because we have not found it necessary in the decision-making process.)

The Teaching Research System has proved acceptable to both teachers and parents. It was originally developed by our staff for use in their classrooms and in the classrooms of those whom they train. Since teachers are known to have little spare time for record keeping, all data systems must be designed so that no extra recording operations are necessary. Thus, our system requires that teachers record data and make computations only once a week.

Parents have found this recording system easy to use in the home as well. The parent training network in Oregon (consisting of 21 parent trainers located in 19 counties) has used this system exclusively. In the period from July 1, 1977 to June 30, 1979, there were 1,275 behavior programs conducted by parents with their children using this system.

*The information presented in this chapter is adopted from Fredericks et al., (1982) Chapter 5, Socialization and Inappropriate Behaviors.

In this paper you will not find a fail-proof technique to deal with that problem child in your classroom or in the home. Rather, you will learn the skills to design a behavior program and to collect data which will allow you to analyze the success of your program and to determine what modifications to make should you be unsuccessful. With that in mind, let us begin.

Underlying Principles for Behavior Programming

One of the underlying principles on which all behavior programming must be based is consistency in the reactions of adults to the behaviors of the child. A child who requires remediation of an inappropriate behavior usually has been engaging in that behavior over a period of time. However, adults who have tried to remediate these behaviors have usually tried various approaches for only short periods of time, none sufficiently long enough to allow any favorable behavior change. Not seeing an immediate change, they switched to a different strategy. Thus, there usually has been a history of inconsistency with the child. To insure that consistency is achieved in the classroom after a program for inappropriate behaviors is implemented, the program is maintained for one week before considering change.

The second major principle under which all behavior programs operate is that the end goal is to control the child's behavior by the natural consequences of the environment. Since this is the goal, most programming should probably start with the utilization of natural consequences in the environment (such as social reinforcement, ignoring or verbal corrections). The use of tangible reinforcers or token systems is usually inaugurated only after it has been demonstrated that consistent social programs will not achieve the desired behavior.

Types of Inappropriate Behavior

For purposes of discussion, inappropriate behaviors have been categorized into four major areas. The first of these is known as self-indulgent, and incudes tantrumming, crying, pouting, sulking, screaming, tapping, clucking and making nonsense noises not usually included under the definition of self-stimulation behaviors.

The second category includes all forms of non-compliant behaviors. These are exhibited when children say "no" when asked to do something, when they do not do something because they forget or when they choose not to do what is asked. The second category includes the non-performance of routine behaviors. It also encompasses children who do the required task but do it poorly, sloppily or incompletely; children who do what they are asked but only after repeated commands or requests; and children who do what they are asked but only with much argument and hassle.

The third behavior category is aggression, both physical and verbal. Such actions as hitting, pulling, pinching, striking, pushing and destroying or taking property are included under this heading. Verbal aggression such as cursing or screaming at someone can also be included in this area, although they frequently are identified as self-indulgent behaviors.

The fourth category of inappropriate behavior is self-stimulatory or self-destructive behaviors. Self-stimulatory behaviors such as filtering, rocking, or playing with parts of the body, and self-destructive behaviors which cause damage to the person are included in this category.

Steps for Behavior Programming

All behavior intervention programs have seven steps: 1) pinpointing and accurately defining the behavior, 2) baselining the behavior, 3) establishing a terminal objective, 4) designing and implementing the behavior program, 5) analyzing the data, 6) modifying the program as

necessary, and 7) insuring that the behavior change is maintained over time. Each of these steps is discussed below.

Pinpointing and accurately defining the behavior. It is necessary to define precisely the behavior identified for possible treatment. Aspects of the behavior should be pinpointed as clearly and concisely as possible. It should be identified, for example, where the behavior occurs (i.e., in the bus, on the way to school or in the group area). The behavior should be categorized as self-indulgent, aggressive, non-compliant or self-stimulatory.

A behavior must be accurately defined so that changes in its intensity and characteristics can be noted if they occur. For example, a tantrumming child may be throwing him or herself on the ground, screaming and kicking. As this behavior is treated, data indicate no reduction in the number or length of the tantrums. However, observations indicate that the child has ceased throwing him or herself on the floor and now only stands and screams. Some of the original behaviors included in the definition of the tantrum have disappeared. Thus, it can be concluded that the treatment procedures which were used were effective in that they produced a less severe form of the behavior. The teacher faced with this change of definition must proceed on the assumption that the behavior is now different.

Other dimensions of specific behaviors for various categories must be carefully observed. For instance, in the area of aggressive behaviors, one must determine who receives the child's aggression--sibling, playmate, classmate, parent, teacher or other. The type of aggression must be carefully noted. Is the child hitting, pinching, scratching, biting, or are numerous of these behaviors combined? How hard is the child hitting? Again, it is important to note the intensity of the aggressive behavior.

In the category of non-compliance, one must know whether the behavior is spontaneous or whether one is dealing with a non-compliant child who consistently does not do prescribed tasks. In the latter case, one must determine whether the parent is going to cue the child to do the behavior or not. For self-stimulatory behaviors, one must accurately describe the particular behavior and also note in what environment it occurs.

In addition to observational baseline data, another form of assessment may be useful. One that we have found particularly helpful is the Walker Behavior Problem Checklist (Walker, 1970). Although normed on an elementary population, we have found the Walker checklist suitable for preschool children. This instrument can be completed in 15 minutes by a teacher or parent and provides a relatively complete list of inappropriate or asocial behaviors. Furthermore, the Walker can be used as a pre/posttest. By having the teacher and each parent complete the instrument, the teacher's and parents' perceptions of the child can be compared.

Baselining the behavior. After the behavior has been identified, the next step is to take baseline data on it. Baseline data depict the parameters of the behavior prior to introducing treatment. Its purpose is to provide a base which can be compared to subsequent treatment data so as to measure behavioral change. Baseline data also enable the program designer to set realistic program objectives for the behavior.

Ideally, baseline data should be taken for one week. A minimum would be three baseline observations. No changes or treatment should be made during this period. If during this period the behavior improves, treatment should not be initiated, but the baseline should be continued until it ceases to improve.

Prior to gathering baseline data, it will be necessary to choose the method of data collection. In doing so, one must be realistic about staff time to collect such information. It is better to have a small, accurate sample of data, than a longer, but incomplete sample. The following are guidelines for choosing a method of data collection:

Table 1
Baseline Data for Tantrumming, Aggression, and Non-Compliance

Child's Name: Bill

Date Recording Initiated: 7-18

Date Recording Terminated: 7-22

TANTRUMMING	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY	TOTAL
Number	1	11	1	111	11			9 1.28/day
Length	11 min.	4 14	3	21 2	11	7 10		83 X = 9.22
Complies	1111	11	1111 1	1111	1111			22 % = 32%
Does Not Comply	1111 111	1111 1111 111	1111 1111	1111 1111	1111 1			46
Hits Peers	1	1		11	1			5 X = 1.0

23

Oct. 23

1. For behaviors that occur very frequently, it will be easier for observers to be accurate if they observe for a short period of time. Measure the frequency and/or duration, but only for a specified time. This would be a sample of the behavior.
2. For difficult-to-observe behaviors (where two observers cannot agree as to when the behavior starts or stops), use an interval recording. That is, for a specified observation, simply record whether or not the behavior is occuring at intervals of time.
3. For lower-frequency or readily observable behaviors, use a frequency and/or a duration count. The length of the time observed depends on staff time available.
4. When little time is available for observing a behavior, observe for a short time sample. It is best to record at the same time each day.
5. The most accurate method, of course, is to measure as many parameters of the behavior as possible. For example, in determining a reinforcement schedule, the most accurate method is to record the time between occurrences as well as the frequency and duration of the behavior.

Although there are a number of ways to measure any particular behavior, the following have been found most useful by classroom teachers.

1. Self-indulgent behaviors. Measure the frequency and duration of the behavior.
2. Non-compliant behaviors. Measure the number of compliances and the number of non-compliances.
3. Aggressive behaviors. Measure the frequency of the behavior.
4. Self-stimulatory behavior. These are most difficult behaviors because they generally occur at a high frequency. A sample of the frequency and/or duration may be measured for a short time, or observations may be made at intervals over a longer time.
   a. If the self-stimulatory behavior occurs across a number of environments, baseline each environment in which the behavior occurs. We have found that treatment does not initially generalize across environments, and it may be necessary to design treatments for a number of them.
   b. After baselining a number of environments, prioritize them and begin a treatment program in one environment at a time. It is usually easier to start with the environment in which the behaviors are occuring at the lowest frequency, as success will be more easily observed by the individual, family and programmer.

Baseline data are recorded on a form similar to that shown in Table 1. This table shows data being taken on three different behaviors: tantrumming, compliance and hitting peers. The data taken for tantrumming measures two dimensions, the number and the length of each tantrum. The frequency is totaled, as is the total number of minutes. A rate per day is calculated (consult Table 2), which in this particular case is 1.28. The average length of tantrum is established by dividing the total number of tantrums into the total number of minutes the tantrums occurred--in this case, the average length is 9.22 minutes. With compliance behaviors, both the number of compliances and the number of non-compliances are computed so as to achieve a percentage. In the case shown, the total number of compliances is 22, the total number of non-compliances is 46, and the percentage of compliance is 22/(22 + 46), or 32%. Aggressions are computed by a frequency count. In this example the observation period is the entire day. Therefore, a rate per day is computed--five instances divided by five days or 1.0/day. If the observation period was less than the entire day but was for the same length of time each day, a rate per day could be computed. If the length of the observation

Table 2
Ways to Measure Behavior

FREQUENCY

DEFINITION: A measurement of how often a behavior occurs.

FORMULA: $\frac{\text{Total \# of occurrences}}{\text{Total time behavior was observed}}$ = Rate of occurrences per minute/hour/day

EXAMPLE: $\frac{\text{10 tantrums}}{\text{5 days measured}}$ = 2 tantrums per day

DURATION

DEFINITION: A measurement of the length of time a behavior occurs.

FORMULA: $\frac{\text{Total length of all occurrences}}{\text{Total \# of occurrences}}$ = Average length of each occurrence

EXAMPLE: $\frac{\text{60 minutes}}{\text{2 tantrums}}$ = An average of 30 minutes per tantrum

PERCENTAGE

DEFINITION: A measurement of how often behavior occurs out of how often it could possibly occur.

FORMULA: $\frac{\text{\# of compliances}}{\text{Total \# of commands delivered}} \times 100$ = Percent of compliance

EXAMPLE: $\frac{\text{20 compliances}}{\text{40 commands delivered}} \times 100$ = 50% compliance

or

FORMULA: $\frac{\text{\# of times chores done independently}}{\text{Total \# of times chores expected to be done}} \times 100$ = Percent of compliance

EXAMPLE: $\frac{\text{6 independent chores}}{\text{10 expected chores}} \times 100$ = 60% compliance

INTERVAL RECORDING

DEFINITION: A measurement of the occurrence of the behavior during or at the end of specified intervals over a standard period of time.

FORMULA: $\frac{\text{\# of times behavior occurred}}{\text{\# of intervals observed}} \times 100$ = Percent of intervals student engaged in behavior

EXAMPLE: $\frac{\text{10 occurrences of behavior}}{\text{20 intervals observed}} \times 100$ = Student engaged in behavior 50% of time observed

period varied each day, the length of time observing would be recorded and rate per hour or minute would be computed.

The data are recorded on Table 3, the Behavior Program Cover Sheet. On this table are entered the child's name, the date the program is initiated and the date it is terminated. This form also indicates where the program is to be conducted and how the data are to be collected. The baseline data together with the date are recorded in the upper portion of the form next to Comments and Treatment.

Establishing a terminal objective. After the baseline data have been computed, a terminal objective is established for each program to be initiated. This objective is entered together with the baseline data on the form shown in Table 3. One form is used for each program. In the case of Bill (the baseline data shown in Table 1), two problems were felt to be serious enough to warrant treatment: command compliance and temper tantrums. The objective chosen for command compliance was "to increase command compliance to 80% for three consecutive weeks." The objective specified for tantrumming was "to reduce temper tantrums to a mean of less than one minute duration and a frequency of 1.4 per week for three consecutive weeks." In setting both of these terminal objectives, the parents were consulted not only about the objectives themselves but also about the treatment program.

Designing a treatment program. As indicated previously, most programs conducted under this system will initially use social consequences. It is hoped that a consistent system of social responses to the child will be sufficient to bring the behavior under control. The advantages of this approach are that such a program is easier to conduct, and no artificial consequences are introduced which the parent may have difficulty accepting or implementing. Moreover, if the program is successful with the use of social consequences, there is no need to later fade out the artificial consequences. In other words, the natural consequences of the environment will be, through their consistent use, controlling the behavior.

The form used in the classroom for designing a program is shown in Tables 4 and 5. Each program is numbered down the left-hand side, and instructions are prescribed as to what to do when the behavior occurs and when it does not occur. Table 4 shows the program for the remediation of non-compliance. In this case, the child is to be socially reinforced for compliance; for non-compliance, he is to be told "no," recued, led through the behavior and then socially reinforced. Table 5 shows part of the behavior program cover sheet for the reduction of temper tantrums. The program numbered "1" specifies that when a tantrum occurs it is to be ignored; when a tantrum is not emitted in those instances when it would normally occur, Bill is to be reinforced socially. In this particular case, the tantrums normally occur when he wants something which he cannot have at that particular time. Therefore, if he were to ask for something, be refused by the adult and not tantrum, he would be socially reinforced.

Analyzing the data. Data are gathered daily on the form shown in Table 1. These data are analyzed weekly, summarized and recorded on Table 3 and compared with the data of the previous week. If the data show an improvement over the previous week, the program remains unchanged. For instance, Table 6 shows the data sheet for the compliance program for Bill. The baseline compliance rate was 32%. During the first week of the program, dated 7/29, the compliance rate increased to 39%. During the next week of the program, 8/5, the compliance rate was 38%. This shows a slight drop from the previous week's 39%. Whenever there is a drop or when the data remain the same, the teacher is required to change the program. That change is entered on the behavior program cover sheet under treatment program implemented. The program modification is labeled Program #2. Under the heading of, "When behavior occurs, do

Table 3
Behavior Program Cover Sheet

Name: _____ Date Initiated: _____ Date Terminated: _____

Program to be Conducted at: Home ( ) School ( ) Both ( )

Baseline Data

Collection Procedure: _____

Date	Data	Comments and Treatment

Program Objective: _____

Synopsis of Program

Date	Weekly Total	Treatment Program Implemented	Date	Weekly Total	Treatment Program Implemented

Post Treatment Follow-Up

Date	Weekly Total	Treatment Program Implemented	Date	Weekly Total	Treatment Program Implemented

If Program Terminated, State Reason: _____

Table 4
Behavior Program Cover Sheet for Bill for Command Compliance Program

Name: Bill

Behavior to be Remediated: To increase command compliance to 80% for three consecutive weeks.

Program No.	(Compliance) When behavior occurs do this:	(Non-Compliance) When behavior does not occur, do this:
1	Socially reinforce.	Say no, recue, lead the child through the behavior, socially reinforce.

Table 5
Behavior Program Cover Sheet for Bill for Tantrumming Behavior

Name: Bill

Behavior to be Remediated: To reduce tantrums to a mean of less than one minute duration and a frequency of 1.4 per week for three consecutive weeks.

Program No.	(Compliance) When behavior occurs do this:	(Non-Compliance) When behavior does not occur, do this:
1	Ignore it.	Tantrumming occurs when Bill is requested to do something. Therefore, he will be socially reinforced each time he complies. See compliance program.

Table 6
Behavior Program Cover Sheet

Name: Bill Date Initiated: 7-18 Date Terminated: _____

Program to be Conducted at: Home (X) School ( ) Both ( )

Collection Procedure: _____

Date	Data	Comments and Treatment
7-22	32%	

Program Objective: To increase command compliance to 80% for three consecutive weeks.

Synopsis of Program

Date	Weekly Total	Treatment Program Implemented	Date	Weekly Total	Treatment Program Implemented
7-29	39%	1			
8-05	38%	1			
8-12	52%	2			
8-19	71%	2			
8-20	74%	2			

Post Treatment Follow-Up

Date	Weekly Total	Treatment Program Implemented	Date	Weekly Total	Treatment Program Implemented

If Program Terminated, State Reason: _____

this," the teacher enters "socially reinforce and give Bill a raisin. " For non-compliance the consequence has not changed. It is "'no,' recue, lead the child through the behavior and socially reinforce." On August 12 the data shown in Table 4 increased to 52% with Program #2; on August 19 it increased to 71%; and on August 20 it increased to 74%. As long as the child is showing continual gain as the behavior approaches the criterion level, the program is not changed.

An exception to the rule that the program should be changed if there is no improvement over the previous week's behavior may occur when an analysis of the week's data is made. For instance, overall data for the week may not show an improvement but may begin to show a trend. This will occur most often when the child, in "testing" the new program, shows an immediate increase in the inappropriate behavior. As the child realizes that the program is going to be administered in a consistent fashion, he or she begins to demonstrate a decrease in that behavior. This phenomenon is most often cited in the literature regarding behavior such as tantrumming which, when initially ignored, will usually increase in length and frequency before it begins to decrease. The experience of the Teaching Research Parent Clinic indicates that this also occurs in other behaviors such as non-compliance and aggression. Therefore, the weekly trend needs to be examined to determine whether or not a reduction is occurring after this spontaneous increase.

There are also other exceptions to the rule. There will occasionally be unusual circumstances in a classroom, when the teacher is sick for instance, and a substitute teacher is employed. During such times, the program is not conducted as consistently as it should be, and the data reflect this deviation. Also, if the child has been absent for periods of time, it is better to gather data for at least three consecutive days before changing the program.

Of course, for those behaviors in which two dimensions are being measured, such as the tantrumming behavior shown in Table 5 where both frequency and length are being recorded, a change may only show in one of those dimensions at a time. If a positive change in either dimension occurs, then the program should not be changed.

Modifying the program as necessary. If the data do not show an improvement and do not fall into the categories of exceptions previously described, then the program must be changed. Thus, each week a decision must be reached, to change or not to change the program. The decision is based on a comparison of the current week's data with that of the previous week.

When the program is to be changed, the general rule is to increase the power of the reinforcer, leaving the punisher constant until all reinforcers have been completely explored. At that point, punishment programs are increased. The experiences both in the Teaching Research Behavior clinic and in classrooms are generally that the reinforcers will be sufficient to modify the behavior without ever having to impose a punisher more severe than social feedback.

Maintaining behavior change. After the objective for a behavior program is achieved for the period of time specified (Tables 4 and 5), the program is put on a maintenance schedule until all exaggerated reinforcers have been faded out. (The child should be responding to the natural consequences of the environment at this point.) For maintenance, the program is checked at one-, three-, six- and twelve-month intervals. This checking is done by again taking baseline data for one week at each of those times. If the data indicate that the behavior has not deteriorated, then no further action is necessary. If the data indicate that deterioration of the behavior has occurred to a degree unacceptable to either the parents or the teacher, the behavior program should be reinitiated.

Conclusion

While a complete description of behavior programming as practiced both in the Data Based Classroom and the Parent Clinic at Teaching Research is available from Teaching Research (Fredericks et al., 1982), the information within this chapter should give parents and teachers a model on which to base carefully documented, consistent behavioral programs in the area of socialization. The data keeping and management system discussed here should accomodate the diverse range of behaviors and training systems encountered and practiced by parents and teachers, and it should help to minimize the effort and time spent in ongoing data collection. Using the data collected in the manner outlined above, both parents and teachers should be able to ascertain which elements of their program are effecting positive change and which elements need modification to improve the social skills of their children.

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COLLECTING DATA ON SOCIAL SKILLS

Karen J. Morris

Curricula in centers for young children traditionally emphasized the development of social skills (Allen et al., 1972; Lazerson, 1972). Although research which adequately defined social behavior and supported the need for an emphasis on social skills was scarce, teachers were concerned about the isolated child who did not interact with peers, the aggressive child who interacted inappropriately and the non-communicative child who failed to share ideas or feelings. Intuitively these teachers felt that improving social skills in young children would lead to increased peer acceptance and, of equal importance, enhanced school success. These feelings have been confirmed by an increasing volume of research published throughout the seventies which emphasized the importance of the social skills needed for positive relationships among preschool and elementary age children (Gresham, 1982; Guralnick, 1978).

The increase in research undoubtly resulted from P.L. 94-142 and the legal mandate that developmentally delayed children be educated in the least restrictive environment. Following the passage of P.L. 94-142 and the mandate, attempts were made to determine how to mainstream handicapped pupils so that the most positive results for teachers and children in the area of social skills would be obtained. Much of the research has validated the importance of social skill development which teachers of young children had previously emphasized. Drabman and Patterson (1981), for example, in reviewing the literature on disruptive behavior and the social standing of exceptional and normal children concluded that similar factors in both groups account for high social standing. Those factors which correlated positively with higher social acceptance were attractiveness, sociability, cooperativeness and conformity to established standards. These authors also concluded that there was a negative relationship between disruptive behavior and social standing, and that all children, handicapped or not, who are in conflict with authority or who demonstrate physical or verbal aggressiveness are rarely accepted socially. It is also important to note that these research results indicated that once inappropriate social behavior was modified the social status of the child changed favorably.

Definition

Although social skill training has long been emphasized, social skills are complex and pose problems for data collection, future development planning and behavior modification. Because social behavior for the young child is actually the integration and expression of many developmental skills such as cognitive, play, communication and motor skills, social data must tap the end result of the interaction of several developmental areas at once. Furthermore, operationally defining the exact social skill to observe and analyze can be difficult enough to discourage much initial data collection. This difficulty is created by the lack of a single, fundamental operational definition of social skills or simple criteria for social competence. Also, while social skills can indeed be taught, many may best be learned through observation and imitation, making the best teaching process less than direct (Bandura, 1969; Gewirtz, 1969).

Despite the complexity of social skill delineation, most teachers consider that social skills fall within the context of increasing, decreasing or eliminating behaviors so that social interactions are positive and occur with appropriate frequency and duration. Foster and Ritchey (1979) define socially competent behaviors as those responses within a given situation which maximize the probability of producing, maintaining or enhancing positive effects for the interactors. While with this definition the range of socially competent behaviors is broad, the definition implies both eliminating disruptive or negative behaviors and encouraging positive behaviors. Through a process of orderly and logical observation of discrete behaviors, social skills can be operationally defined and divided into observable components. This process allows the teacher to identify goals for developing appropriate social behavior that can be taught and evaluated in the classroom.

Measurement

What Data to Collect

Ongoing data collection for social skills can be divided into two major areas: preprogram data and program data. Preprogram data is that information based on structured observation and assessment which the teacher collects to learn about the child's strengths and weaknesses and to determine which methods will best help the child develop new skills. Preprogram data will help the teacher decide which children need special help with social development skills and which instructional plan will best foster that development.

Preprogram data answers such questions as:

1. Does the child's level of functioning indicate that help is needed in the area of social skill development?
2. If so, what social skills need further development?
3. What techniques are likely to be successful in developing the identified social skills?

Program data, on the other hand, monitor the effectiveness of the instructional plan selected on the basis of preprogram data. Program data allow the teacher to determine about when to change a plan for social development, when generalization should occur, when teacher support should be faded and when more advanced skills should be taught. Program data answer such questions as:

1. Are social skills developing as the result of the plan being used for social development?
2. Are these skills generalizing to situations beyond this specific learning situation?
3. When can the special techniques being used to develop these skills be faded or eliminated?

Assessment

A multitude of assessment techniques and instruments are now being used to allow researchers and teachers systematically to observe and document social skills. Asher and Taylor (1981), Hops (1981) and Foster and Ritchey (1979) provide a thorough discussion of the techniques available. All assessment techniques can be grouped into two general categories: those techniques which require direct observation of the subject and allow for systematic recording of a specific behavior observed, and those techniques in which an adult or peer rates the subject's social skills on a predetermined measure. In order to determine which technique would be the most beneficial for collecting data in the classroom, the teacher must first determine what information is needed or what questions he or she wishes to answer. Direct observation is most useful when planning and monitoring individualized programs.

Predetermined measures are particularly useful when considering the overall intervention program and as independent measures to assess gains. Several techniques may be needed.

Direct observation provides the best information on the development of skills such as responding to others, defending possessions, parallel play, sharing and interacting cooperatively. Through direct observation specific questions may be answered such as: how frequently does the child respond to others? under what circumstances does the child defend possessions? and what proportion of the time does the child spend in cooperative play? These questions provide important preprogram data needed before an adequate social program can be developed. Nevertheless, an assessment or rating of a child's social skills on a predetermined developmental scale is also important to obtain when developing a social program for a child. The developmental scale is an assessment instrument which pinpoints the developmental level of a child in the area of social skills and allows for decisions to be made regarding the social strengths and weaknesses of a particular child. The use of developmental scales helps determine the appropriate skills to be taught next. Information gathered through observation and assessment should initially be used as preprogram data and is one of the first and most important steps in data collection in the classroom.

How to Collect Preprogram Data

We have seen that gathering preprogram data requires both assessment and structured observation. Assessment will determine which children need help in social skill development and at what developmental level help is needed; structured observation will further define the social skill and suggest techniques for its development. Tracing the following preprogram questions through this process of observation and assessment offers a structured means of data collection in social skills.

Does the child's level of functioning indicate that help is needed in social skill development? An assessment instrument which developmentally sequences many skill areas such as communication, cognitive and motor is useful in measuring a child's social skills against his or her progress in other developmental areas. When interpreting the result of assessment, it is important to recognize the effect of other developmental abilities on social development. For example, social interaction is dependent to some degree upon the level of communication, play and motor skills. A delay in any one of these areas can be exhibited as a delay in social skills. Consequently, it may be necessary to work simultaneously in another skill area in order to affect social skills. If, for example, a child is delayed in communication skills, continual improvement in communication skills would be essential if a social skill program was going to progress.

What social skills need further development? After identification of the social delay, the teacher must specify exactly what skills a child can and cannot demonstrate. It is helpful to refer, once again, to a developmental sequence provided by assessment. By identifying skills which the child performs regularly, the teacher will be able to obtain the child's approximate age level of functioning. One step beyond this age level on the developmental schedule may reveal the skills which the child is performing occasionally. Through observation the teacher will be able to confirm the frequency with which the child is performing this behavior, and the conditions under which the behavior is most likely to occur. A step further on the developmental scale will reveal those skills which should be emerging in the future, but which do not currently exist in the child's repertoire. Consequently, after a formal assessment and observation, the teacher can divide the child's behaviors into three categories: those skills the

child can do well; those skills the child can sometimes do; and those skills the child does not yet have the ability to do. It is these "sometimes demonstrated" or emergent social skills which the teacher should encourage. Emergent social skills are those the child practices in some situations, with some people or with some materials. By concentrating on emergent skills, the teacher is avoiding the difficulty of teaching an entirely new skill and is able to use the methods that allow the child to learn social skills most efficiently. That is, the teacher can reinforce the child when the child exhibits the behavior, allow the child to learn through imitation by reinforcing other children exhibiting the behavior and help the child gradually expand the setting in which the behavior is used.

The following example illustrates a hypothetical sequence of assessment and observation incorporating the preceding concepts. A teacher, Susan Gilbert, is concerned about a four year old who rarely interacts with other children in the classroom. An assessment instrument assessing motor skills, pre-academic skills, self-help skills, social skills and communication skills indicates that most skills range between the 3- to 4-year level. Of particular importance are communication skills which have developed to the 3 1/2-year level and are adequately developed for social interaction. Cognitive skills close to the 4-year level are also adequately developed and the child should be sharing ideas with peers and teachers during play. The assessment, however, confirms the teacher's suspicions that the child's social interaction skills are delayed, for the child rarely joins in play with other children, rarely interacts verbally or physically in play activities and never becomes involved in activities which require sharing ideas or materials. These observations indicate the child is functioning at or below the 3-year level.

The teacher's next step is to develop a program to strengthen and encourage this child's social interaction skills. Again reviewing the assessment instrument the teacher finds that the social activities the child does well and consistently are those at the 2 1/2- to 3-year level, such as playing near and watching other children in their play and symbolically using materials in isolate play. Social behaviors which the child does sometimes are occasionally and briefly to join in play with one other child during water or sand play. According to the assessment the teacher was using, these skills are at the 3- to 3 1/2-year level. Social activities the child does not do involve engaging in social activities for any extended period of time (that is beyond a brief interaction) or engaging in activities with a variety of peers. These are social skills at the 4-year level.

To determine how to expand upon the skills the child already has, Susan Gilbert observes the child during social interaction and notes those situations in which the child interacts with others. She notes that during play at a water table (a favorite activity) the child initiates interaction with another child by pouring water in his container several times and making frequent eye contact.

The teacher has now identified an emerging social skill which she can reinforce and expand. She also has a sequence for expansion. She can first expand the frequency and duration of this interaction; next she can expand the number of children with whom the child is interacting during this type of play; then she can expand the number of activities in which the child can interact with his friend. The same technique of expanding emerging skills can be used with a wide range of social skills such as participating in parallel play, sharing materials, taking turns or responding in a group.

If no emergent social skill can be observed, the teacher's task is more difficult. First it is important to determine if negative behaviors may be interfering. Often, when skills do not emerge, behavior problems need to be eliminated before new skills can develop. If this is not the case, the best option is to focus on the most recently developed social skill, making sure this skill has generalized to a wide variety of situations. In the process of doing so, the teacher often notes a more advanced skill emerging. A second but less direct option is to concentrate

on those skills which support social behavior such as communication, play and motor skills in hope that the development of these skills will promote social skills. The third and least desirable option is to break down a new social skill into its major components and teach each component separately--a difficult and somewhat artificial task.

What techniques are likely to be successful in developing the identified social skill? Once the level of social development is determined and the exact social skill to be developed is identified, means to define precisely the skill and techniques for the development of the skill must be considered. Again, structured observation serves to define the skill and identify those technique likely to be successful. The A-B-C form (Table 1) is an observation form that allows the teacher to see events which influence the occurrence of the behavior. The middle column is used to describe the behavior as it occurs. This description helps to determine if the behavior is defined in such a way that it can be identified each time it occurs.

Table 1
A-B-C Form

NAME:_____ DATE:_____

OBSERVER:_____ TIME:_____

ACTIVITY:_____

_____

ANTECEDENT BEHAVIOR CONSEQUENCES

_____

The column titled "antecedent" is used for listing the conditions that seemed to cause the observed behavior to occur. Antecedents help the teacher determine what happens immediately before the behavior that may increase the probability of that behavior occurring again. If the behavior is one the teacher wishes to encourage, these conditions can elicit the skill; if the behavior is one the teacher wishes to eliminate, it is desirable to remove the antecedent from the environment.

Consequences are what happens immediately after the behavior occurs and are recorded in the last column. In most cases, these are the responses of children or adults to the behavior. Of major importance are the adult's responses. A behavior that is emerging may elicit different responses from different adults. By observing these different responses, a teacher can determine which consequence encourages or discourages the behavior. This information is important in determining what consistent response all adults should make to help the child develop appropriate social skills.

The information gathered in the A-B-C form can be used by the teacher to increase the probability that an infrequently occurring emergent skill will occur more often. The antecedents will alert the teacher to techniques that should encourage the behavior. The consequences will provide techniques to reinforce properly the behavior when it occurs.

Through close observation with the use of this form a teacher can develop a social program which will include those techniques that are most likely to be successful in developing social skills.

Determining the Criterion for Success

Once criterion, which defines the level of acceptable performance, has been reached, the program should be faded. With social skills, however, a criterion becomes difficult to define. The amount of eye contact a child makes in relating to others is a very individual matter and the normal range varies considerably. Cooperative play, defined as the child playing within three feet of one or more other children and sharing the same materials (e.g., blocks, paint), can vary from 35% to 60% of the observed time for normally functioning children. Further, the opportunity for social interaction among children and for social skills to be displayed are dependent upon the type of activities presented and will vary from classroom to classroom. Keeping these considerations in mind, a minimum level of expectation should be developed which can be used as a criterion. This criterion level can best be set by sampling the occurrence of the defined behavior in other children in the classroom. Without this sampling, the criterion level can often be set too high. Once the child has met this criterion for a reasonable length of time techniques can be faded, but checks on the behavior should continue for several months. The length of time necessary to ensure maintenance depends specifically on the target behavior. Simple and direct behaviors, such as handing materials to another child on cue, can be considered learned if the child responds successfully for two or three days in a row. For more complex behaviors, such as cooperative play, the teacher may wish the child to reach criterion for several weeks before he or she feels the child will continue the behavior without specific structuring by the teacher.

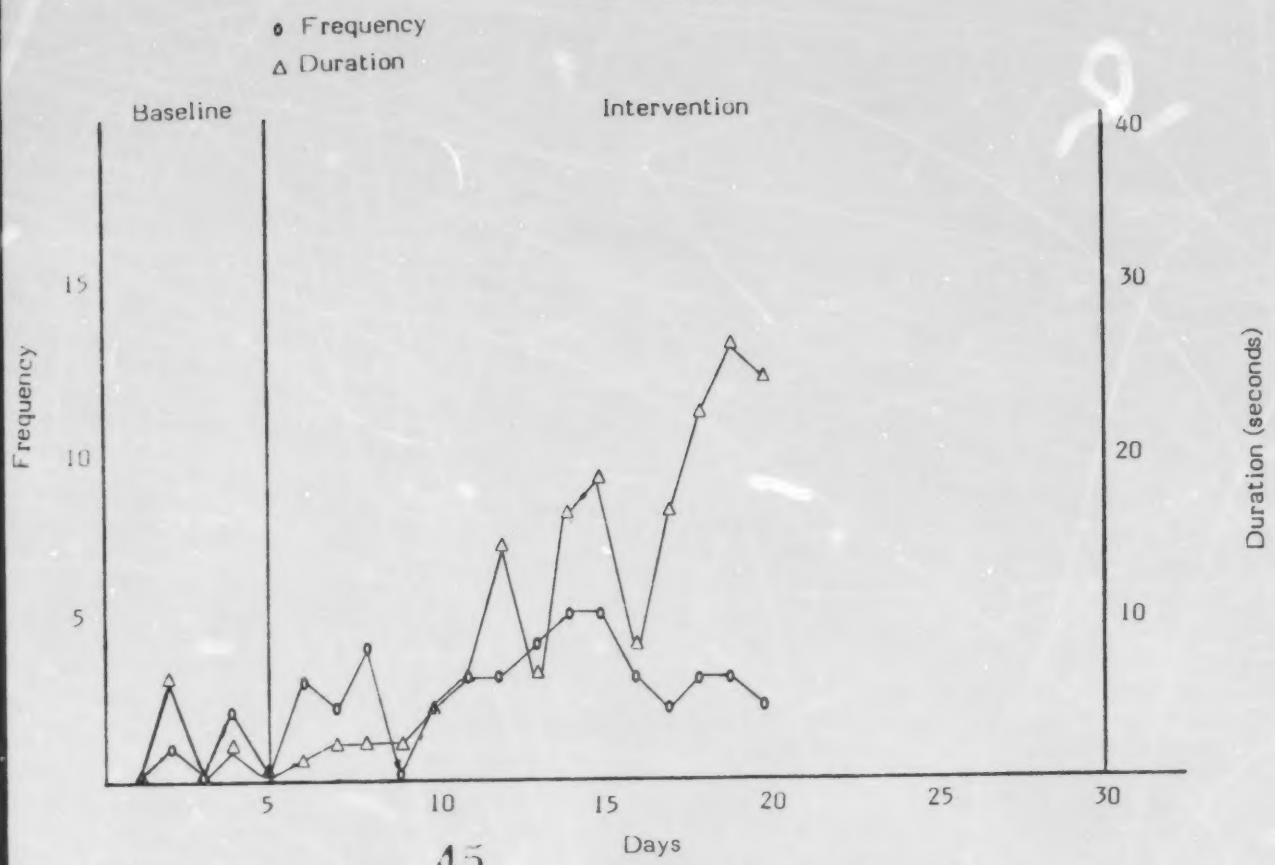
Data Based Program Planning

To plan the program the teacher should progress through the following steps. With the use of an assessment instrument, he or she first determines if social skills are deficit. Through reviewing the assessment instrument the appropriate target behavior is identified. The behavior is observed carefully to identify antecedents and consequences, and to help in precisely defining the behavior so techniques for encouraging behavior can be developed. Then frequency and duration data are gathered to learn more about the behavior and to establish baseline. Finally, all of this data is examined, and baseline data is plotted on a form such as Figure 1. The baseline data along with other information the teacher has gathered will confirm need for a change in the child's social program. The combined data can then be used to set goals, plan prompts and cues, prepare conducive settings, determine criterion for success, and to arrange effective consequences for implementing the social behavior program.

Four guidelines for incorporating these techniques into program development should be followed.

1. Minimize the complexity of any program by dealing with only one behavior at a time.
2. Start the program for only a short period of time (e.g., 10 minutes), and gradually expand as the success of the program is determined. This not only takes the pressure off of the teacher and the child, but also assures a definite time when the program will be run and data collected.
3. Ensure that the techniques used are agreed upon and well understood by all adults working with the child.
4. Plan programs which are consistent with the philosophy of the teachers and the time they have available.

Figure 1
Social Interactions



How to Collect Program Data

Program data are extensions of preprogram baseline data. However, with program data the teacher must constantly evaluate the results of the intervention. It is through this analysis and evaluation that it is determined if the current techniques for expanding social skills are effective and if program decisions regarding generalization need to be made. To make these decisions effectively the data must be displayed in a way that allows it to be easily "read." Although a variety of techniques are acceptable, graphing the data provides the most visible evidence of success or failure.

The type of data to be used should be decided upon as the child's social development program is planned. Ideally, data should be taken daily, though practically, daily collection is not always possible. The only way to guarantee that data is taken often enough is to plan data-taking time into the weekly schedule and to assign an individual the time and the responsibility for taking the data needed.

The data, if it is to be taken on a behavior which is increasing, should show a gradual upward trend. This does not mean that each successive data point will be higher than the one before. Behavior is variable, and social behavior, in particular, tends to be more variable. The behavior may increase, then decrease, but the general trend should be upward. If after about two weeks this upward trend is not apparent, the program needs to be re-evaluated.

Referring to Figure 1, assume the teacher's goal is to increase interactions to three interactions lasting 40 seconds each during a 10-minute observation period. The data show that on day 20 behavior was variable and had averaged 2.8 interactions the first week, 4.0 interactions the second and 2.6 the third. Interactions, thus, were decreasing. Duration of the interaction averaged 2.2 seconds the first week, 12 seconds the second and 19.2 the third. The child, then, while reaching the goal of increased duration of interaction, is falling from the goal of increased frequency. Thus, the teacher needs to examine the program to determine means to maintain frequency of interaction.

If the program is not effecting a change of behavior, data should be collected to determine why. First, the behavior of the individuals carrying out the program needs to be monitored. It is essential to ensure that the program is carried out consistently and as planned. If monitoring indicates that the program is carried out correctly and consistently, options for program change need to be explored.

It should be remembered that major errors in running social programs are produced by expecting results too quickly and consequently charting the program before the adults and the child have had a time to respond appropriately. Additional confusion may be created by changing too many variables. Changes must be systematic and based on collected data.

How to Measure the Behavior

Measuring the behavior produces data showing the rate of occurrence and the extent of the social behavior. Two questions are of major importance in measuring social behavior: "How often does the behavior occur?" (frequency) and "How long does the behavior last?" (duration). Consider the example of the child whose initial social interaction is simply pouring water into a friend's container. The teacher's first objective might be to encourage this interaction to occur more often. He or she would keep a record of the number of times the child exhibited the behavior during a specific time period. Once the frequency of interaction had increased to an appropriate level, the teacher's next concern might be the duration of the social interaction. He or she would then develop techniques that would encourage the child to interact with others for a longer period of time. Frequency and duration data are both needed to document social

development, but duration data, an indirect measure of the quality of social skills, is most often used to assess the extent or quality of social interaction.

Frequency data. Collecting frequency data consists of noting the number of times the behavior occurs. When frequency is considered in relation to the length of time the child was observed rate data is developed. A method of measuring frequency is to use tally marks for each occurrence and to record the time at the start and finish of the observation. Rate is obtained by dividing the number of occurrences by the length of time of the observation. If, for example, the child poured water into his friend's container two times within a 20-minute observation, he would be interacting at the rate of .1 interaction per minute. This figure, (.1/minute), is best expressed as interacting once very ten minutes.

Some important principles must be kept in mind when taking frequency data.

1. The behavior must be well defined in the process of taking preprogram data or tally marks become difficult and unreliable.
2. Use the data to answer the question, "how often does the behavior occur?"
3. Frequency data is best taken on quickly occurring behaviors that have a well-defined beginning and end, such as passing materials, touching, grabbing, smiling and responding.
4. In order for the data to be meaningful the length of time of the observation must always be recorded.

Duration data. Duration data show the length of time the behavior occurs in relation to the total length of time the child was observed. The best method of recording duration data is by starting and stopping a stopwatch as the behavior begins and ends. The length of time recorded on the stopwatch, plus a recording of the time at the start and finish of the observation, is needed to determine the duration of social behavior. Duration is obtained by dividing the length of time the behavior occurred by the length of time of the observation period. The resulting figure indicates the proportion of the observed time that the behavior occurred. For example, if a child is involved in parallel play for ten minutes out of a 20-minute observation, the data would indicate the child was involved in parallel play .5%, or 50%, of the observed time.

Two important principles should be kept in mind when taking duration data.

1. Duration data is often used to monitor ongoing or extended behaviors such as parallel play, cooperative interaction, group participation, crying or singing. Because of the complexity of these behaviors, definitions must be precise and given considerable prior thought.
2. The length of the interaction can only indirectly reveal the quality of the interaction.

Other Measures. In addition to recording the frequency and duration of a behavior, more elaborate data systems can be devised to record several functional components involved in a social behavior. In these systems, data are usually recorded by time sampling. Several behaviors are defined and then recorded simultaneously during a continuous 10- or 15-minute observation. These systems have the advantage of allowing the observer to determine how the interaction of specific behaviors affects an ongoing social behavior. While observing a specific child, the recorder may note the number of instances of teacher attention, verbal interaction with peers, and the type of play (isolate, parallel, cooperative) that occurs during a continuous 10-minute time period. It is then possible to determine the relationship among the amount of teacher attention, type of play and verbal interaction with peers. While the information provided by these coding systems is extensive, a word of caution is necessary, for their complexity makes them time consuming and very often makes reliable data difficult to attain. Most classroom data questions can be answered through the observation of discrete behaviors

and the recording of frequency or duration data.

Generalization

Generalization of social skills should be pursued as actively as planning and teaching these skills. Teachers concerned with changing a child's behavior to an acceptable standard rarely plan programs with generalization in mind. Instead, once criteria is met, and if time and facilities allow, generalization is introduced as a second phase of the program. This secondary emphasis upon generalization results from two factors. First, current methodology for practical application of generalization techniques is limited, and second, studies in the area rarely provide techniques capable of being used by teachers in the classroom. Methods adaptable to the classroom, however, have been suggested by Walker (1979).

Walker (1979) concedes that the highly effective technology which has been developed to produce changes in behavior does not lend itself to generalization. He feels, in fact, that the success of a program should not be judged by how well it generalizes. He does, however, suggest two straightforward methods of generalization. The first is simply to extend the entire program, once it has stabilized for the child, to other classrooms or areas where the child is experiencing difficulty. The second is to work with social agents within these other settings to reinforce and support the child's changed behavior. The success of these techniques are based on the cooperation of other social agents and the time and facilities available to the teacher.

Stokes and Baer (1977) are more optimistic about the ability of programs to generalize. After classifying generalization studies under nine headings ranging from "train and hope" to "train to generalize" they offer the following suggestions.

1. Plan programs that call for stimuli and responses likely to be found in the natural community.
2. As a minimum use two teachers in the training program. It is assumed that the larger and more diverse the examples the better the program will generalize once the program has been learned.
3. Loosen or delay reinforcement to make unclear the limits of training and the time or place in which the contingency actually occurs.
4. Reinforce generalization when it does occur and fade this reinforcement; also reinforce self reports of the desirable behavior.

Often classroom programs on social skills are entirely dependent upon the skill and response of the teacher. The contingencies then become a teacher's response rather than the natural environment in which the child operates. In order to generalize, the behavior must be responsive to all adults, peers and equipment the child will meet in an extended environment.

Summary

The major portion of this chapter deals with procedures necessary to plan and to develop an adequate social program. Time and effort spent on planning a program before it is put in effect pays off in the development of a program which has a high probability of success. Although success of a program can never be determined until it is put into effect, keeping changes at a minimum will ensure a more consistent program resulting in more rapid social change.

Planning the program requires the following steps:

1. Assessment, to determine the need for a social program;
2. Review of the assessment data, to pinpont the social behavior to be developed;
3. Observation, to develop an understanding of what circumstance has the highest probability of eliciting the desired behavior; and
4. Data taking, to determine the frequency and/or duration of the behavior.

These steps, in addition to helping the teacher understand and define the behavior, will establish baseline information needed later to determine whether or not the program is effective.

Of major importance in developing social behaviors is the emphasis on expanding social behaviors rather than on developing new social behaviors that are not in the child's repertoire. New behaviors can be encouraged by developing a program concentrating on behaviors that occur infrequently but naturally rather than by attempting to "task-analyze" and develop an entirely new social skill.

Once a program is developed the teacher must constantly analyze the data and monitor the program to determine if the program is being implemented effectively and consistently and to determine if behavior is in fact changing. Although the constant monitoring of discrete behaviors and analysis of program effects in social programs can be difficult and taxing for a teacher, there is no doubt about the need for these programs. Gathering accurate preprogram data to facilitate accurate planning can save much time and ensure appropriate techniques for encouraging social development, while gathering program data will ensure the original techniques are producing appropriate and anticipated results. Thus, through the ongoing collection of data, a child will be guaranteed an optimal program for developing his or her social skills crucial to peer acceptance and late school success.

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ASSESSMENT AND MODIFICATION OF COGNITIVE PROCESSES OF HANDICAPPED CHILDREN*

William A. Bricker, Patrick R. Macke, Jean A. Levin, & Thomas J. Simmons

Defining Cognitive Processes

The terms cognition and intelligence are used almost interchangeably in child psychology and education. They are the two magic words of human development. To be intelligent is to be capable of the highest order of cognitive activity, and to do the latter defines the former. No image of this principle is more pervasive than that of Albert Einstein who, in his old sweater, his kindly smile and relatively unkempt hair and moustache is the personification of cognitive activity. He is the "criterion of ultimate function" for all of us because he made the unthinkable not only scientifically testable, but also practical. The properties of mass, energy, space, time and the principle of relativity are now better understood because of the cognitive operations of this person.

Although his primary scientific interest was in the area of physical science, there is an interesting resemblance between Einstein and the man who devoted over fifty years of inquiry in the area of genetic epistemology, Jean Piaget. This resemblance is not so much of particular physical attributes as in the mode and outcome of their lives. Both applied their respective abilities to the highest form of human behavior, referred to by Piaget as the use of formal operations. In formal operations, theoretical abstractions are used systematically to relate the facts of human experience into sets of coherent structures that simplify the requirements of human existence. Laws, principles, rules and the other formulas of science are the means by which the multitude of empirical events can be brought together, ordered, understood and then used in various ways--including the identification of means for improving human existence. This is as true in the study of human cognitive development as it is in the physical sciences. This is also a point of no small significance in determining what to measure and what to change in the realm of cognitive development of handicapped children.

Theoretical Considerations

A fallacy pervasive in the literature of child development is that we can depend upon the concept of a "homunculus" to explain child behavior. This position is generally expressed in terms of an intellectually active child-agent who processes information, makes decisions, and, in the most general sense, determines the course of the child's developmental progression. A convenient example can be found in the following quotation:

> Currently, fundamental gaps exist in our knowledge. We are essentially ignorant of an "at risk" infant's ability to handle information, and we have been inattentive to the resources infants mobilize to meet changing situations and tasks . . . . In the young infant, information processing encompasses ability to focus on stimuli, to control

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attention, and to store, retrieve, and exchange simple kinds of knowledge. (Kopp & Parmelee 1979, p. 62)

This statement was imbedded in a scholarly summary of prenatal and perinatal influences on behavior. The conclusions drawn by the writers indicate that analyses of such information processes in "non-risk" infants should also become a part in the analyses of "at-risk" groups of infants. The objection that we are making is not the usual one found in the behavioral literature that such inferences are not justified given the data base upon which they are constructed, but rather that such statements cannot be true either logically or in relation to the processes of genetic epistemology (Piaget, 1980). This was made explicit by Francis Crick (1979) who, in discussing his own transformation from a microbiologist to a neuroscientist, stated:

> Is there any idea we should avoid? I think that there is at least one: the fallacy of the homunculus .. most neuroscientists believe there is no homunculus in the brain. Unfortunately, it is easier to state the fallacy than to avoid slipping into it. The reason is that we certainly have an illusion of the homunculus: the self. There is probably some good reason for the strength and persistence of this illusion. It may reflect some aspect of the overall control of the brain, but what the nature of that control is we have not yet discovered. (p. 224)

The importance of such cautionary statements is not readily apparent when dealing with the literature on normal child development because the sequence and organization of behavioral development is so predictable and brought under the control of verbal regulations at such an early age. However, when one turns to the developmental profile of a brain-injured or Down's syndrome child, reduction in rate of development is often attributed to the central organization of the homunculus rather than to a more objective analysis of how the nervous system is operating relative to the variety of determiners existing each moment in the handicapped child's life.

The task before us, then, is to define those aspects of human behavior that have been identified as important cognitive performances and to describe briefly the developmental sequence through which behavior must move--from the reflexive responses of the infant to the "higher order" or formal operations of the adult. We will also need to establish some rules of measurement and modification that we can use to influence the course of cognitive development of moderately to profoundly handicapped children. Given the amount that has been written during the past few years about cognitive development, any attempt to deal with these issues in only a few short pages may seem cursory; but in this domain, less may be preferable to more.

Like most words describing human behavior, which are not based totally on observable aspects of that behavior, the definition of a process such as cognition is arbitrary. The key element in the definition of cognition is organization, and the development of cognition is typified by increasingly complex degrees of organization. The major implication of Piaget's account of cognitive development is that all behavior--starting from the reflexive behavior of the infant--is organized (Piaget, 1952). A reflex is considered to be one of the most primitive forms of human organization, and in the reflex we can see the base structure from which all subsequent organizations must emerge.

Piaget brought into the open with great clarity that in the organization of the reflex we see how the environment and the existing organization of the individual must interact to produce the next higher level of organization. When we place nipple in the context of reflexes, we have little difficulty seeing the relationship between the nipple stimulus and the sucking

response that typifies the sucking reflex. However, we would not be so quick to see the same response when we bring forth a blunt number two pencil. What does the pencil have to do with reflexive behavior? We could carefully cleanse the eraser end in an attempt to have the infant suck it. He or she might do so or might attempt to reject it by turning his or her head from side to side. A more suitable use of the pencil would be to elicit the grasping reflex of the infant or to rub the blunted end along the plantar surface of the infant's foot to elicit the Babinski sign. Organization is seen in two facets of these situations. First, the reflexes are set to respond but will do so only in the context of a fairly narrow range of stimuli. Second, the response is not defined in the nature of the stimulus in any exact sense. A pencil is generally used for writing and not for eliciting sucking, grasping or the plantar reflex. The reflex is actually produced by the individual's interaction with various properties that can be shared by a wide range of stimuli. A fat crayon could elicit the grasping or perhaps the sucking reflex, but probably not the Babinski. The nipple might elicit only the sucking reflex; an elephant might elicit no reflex at all.

The important point here is that the reflexive responses of infants do not occur randomly, but are organized to occur only in the presence of certain environmental stimuli. This same relationship exists in all stages of human development. For example, a child's response to the stimulus "Tell me about a wolf," would not surprise the average listener if it were "He huffed and he puffed and he blew the pig's house down!" or, "He jumped out of bed and chased Little Red Riding Hood out of the cottage!" or even, "The wolf is becoming an extinct species as a consequence of hunting and a depletion in the number of prey." In each case, the response is organized relative to the nature of the stimulus, and in each case the response is not actually given by the nature of the stimulus. Something had to intervene in the life of the child to make any of the three responses possible in the first place, and something had to take place within the child to hold that response in relation to that stimulus across time. Such factors form a starting point for the analysis of cognitive development and instruction.

Assessment methods derived from the work of Piaget and his colleagues are readily available. For example, the basic introduction to sensorimotor assessment may be found in Dunst (1980) and Uzgiris and Hunt (1975). Variations on this assessment theme were set forth by Corman and Escalona (1969), and applications of the measurement system and the cognitive mode of analysis to the handicapped are offered by a number of writers (Bricker, 1976; Kahn, 1976; Robinson, 1976; Robinson & Robinson, 1978; Stephens, 1977). The principle content areas in both assessment and in preliminary intervention have generally included sensorimotor processes such as motor and verbal imitation, the concept of the permanent object, physical causality, functional classification of objects and practical knowledge of space and time.

As originally described in The Origins of Intelligence in Children (Piaget, 1952), each of these sensorimotor processes is represented in a hierarchy of invariant stage development. The first stage, which involves the exercise of genetically determined reflexes, provides the basis for the first adaptations of the infant or changes in "eliciting" stimuli for sucking, grasping, looking, listening and other reflexive movements produced by various classes of stimuli. The second stage involves primary circular reactions, in which the frequency of the infant's movements are temporarily increased or decreased as an outcome of various differential consequences produced by the movements, such as the sounds of a rattle. The third stage is represented as secondary circular reactions in which the infant or young child has differentiated various objects on a more permanent basis; he or she does not rediscover the available consequences on each new contact with an object. In the fourth stage, the young child is viewed as coordinating the secondary reactions in such ways as imitating new movements,

indicating "intentional" behavior, developing means-ends relationships and demonstrating search behavior. The fifth stage described by Piaget involves tertiary circular reactions, which are best described as novelty-seeking situations in which the young child moves past previously experienced toys, people and furniture to contact something new in the environment. In the sixth and final stage of the sensorimotor period, the young child is capable of inventing new means through mental combinations. This final stage is characterized by the appearance of deferred imitation, symbolic play and the semiotic function (i.e., language). This sixth stage will be discussed briefly at the end of this paper.

The content of the sensorimotor period and the stages through which behavior passes during this period are two of the critical dimensions of Piaget's approach to cognitive development. The third dimension involves the mechanisms of change which Piaget terms the methods of adaptation. When the infant or young child encounters a new situation or a new object, there is some disequilibrium produced if the situation or object doesn't match those previously encountered. One method for reducing disequilibrium and producing adaptation is to assimilate the new event into existing modes of organization, such as by extending the sucking reflex to a pacifier with a new kind of nipple or learning to pull the ring of a talking toy. Extending the existing organization to the new object or situation also involves some basic changes in the pattern of response that is part of the orgaization. The sucking behavior may have to be adjusted to the physical characteristics of the new nipple, so that the lips and tongue may have to be positioned in a new way to achieve the sucking response. The fingers may have to be used in conjunction with the arms in a new manner to accommodate the requirements of the talking toy. When this new form of behavior occurs, Piaget would say that the infant has adapted by accommodating the new event. For Piaget, assimilation never occurs without accommodation, and accommodation is impossible without assimilation. Piaget also believes these mechanisms of change are universal in that they reoccur at all stages of development and are found in all content domains. Such considerations form the basis for measurement and modification.

Operationalizing Cognitive Development

The variations among psychological theories of human development appear to occur as a function of the degree to which unobservable internal events are used to predict and explain behavior. Skinner (1969, 1974, 1978) has taken the most conservative position on this issue by advocating and vehemently defending a fact-finding experimental procedure that systematically relates observable environmental events surrounding behavior and the resultant changes in behavior. His position has been frequently criticized in relation to human behavior (Anastasiow, 1981; Chomsky, 1959; Weimer, 1973), and sometimes simply dismissed (Bates, 1979). For the past ten years, this writer and his colleagues (Bricker, 1970, 1976; Bricker & Bricker, 1974, 1976; Bricker, Macke, Levin, & Campbell, 1981; Filler, Robinson, Smith, Vincent-Smith, Bricker, & Bricker, 1975; Lynch & Bricker, 1972) have attempted to demonstrate the utility of a theoretical synthesis between the principles of an experimental analysis of behavior and the less conservative positions that have been termed "cognitive" (Bruner, 1964, 1973; Inhelder & Piaget, 1964; Piaget, 1952; 1980) or even "mentalistic" (Chomsky, 1980; Fodor, 1981). As indicated by Robinson and Robinson (1978), nearly every aspect of sensorimotor behavior described by Piaget can be both defined in behavioral terms and modified using contingency management strategies. Whether a behavioristic approach in and of itself is sufficient to solve the problem remains an empirical question. The information that follows considers this issue.

Primary Circular Reactions

The subject of reflexive behavior is of little use theoretically, although the existence of reflexive behavior is critical to all subsequent development. In reflexes are found the basic forms of organism-environment interaction, which, when elaborated, become the more complex organizations of infants and young children. However, the reflex does little by itself except function. The critical feature for development is the consequence of the reflexive movements. For example, placing a rattle in the hand of an infant will generally elicit the grasping reflex, but when the infant moves the hand and makes the rattle produce sounds, we have a consequence that can accelerate the frequency of the movements. Piaget has termed this relationship the primary circular reaction: if the infant finds the outcome of shaking the rattle interesting, he or she will tend to repeat the movement.

How can we decide whether the infant is interested in the noise? If he or she shakes the rattle more frequently or with greater vigor, then we must assume some degree of interest. A behaviorist reads such an account of the primary circular reaction and wonders what has been added to the basic operational definition of reinforcement. Any consequence that is associated with an increase in the rate or probability of occurrence of the preceding behavior is said to be reinforcing. Considering the similarity between the two descriptions, the decision of which explanation to accept is obviously arbitrary. If Piaget is the preferred approach to development, then the process is usually described in terms of the primary circular reaction; but if Skinner or another behaviorist is the preferred approach, the same process is usually referred to as free field operant conditioning.

Secondary Circular Reactions

If the primary circular reaction is a matter of some debate between the behavioristics and cognitive advocates, the domain of secondary circular reactions as described by Piaget brings the debate into greater intensity. Consider the following statement by Piaget in his attempt to differentiate the primary and secondary reaction:

> We can call the circular reactions of the second state 'primary'. Their character consists in simple organic movements centered on themselves (with or without intercoordination) and not destined to maintain a result produced in the external environment. So it is that the child grasps for sake of grasping, sucking, or looking, but not yet in order to swing to and fro, to rub, or to reproduce sounds. Moreover the external objects upon which the subject operates are one with his action which is simple, the means being confused with the ends. On the other hand, in the circular reaction which we shall call 'secondary' and which characterize the present stage, the movements are centered on the result produced in the external environment and the sole aim of the action is to maintain this result; furthermore, it is more complex, the means beginning to be differentiated from the end, at least after the event. (1952, p. 57)

When Piaget says that the primary circular reaction involves outcomes that are one with the actions that produce them, he means that the infant is likely to do the same thing with every object that comes into a grasping, looking or sucking reaction. All objects elicit about the same form of behavior, even though some that produce particular consequences are associated with a temporary increase in the rate of the response. In other words, objects or people are not differentiated at this level, and there is little evidence of memory that relates events at one point in time with events in the near future. Each encounter with the

environment is both novel and independent in terms of other encounters in the future, even if they are of exactly the same kind. However, in the stage of secondary circular reactions, what Piaget means by discussing the separation of means and ends is that certain encounters are differentiated in terms of what objects have been found to be good for in the past. Thus, rattles are for shaking, pacifiers are for sucking, sticks are for banging the side of the crib and parents are for smiling at. Objects, then, have a primitive form of functional meaning which persists across time.

A behaviorist looking at the same factual data would deal with the change from primary to secondary circular reactions in terms of discrimination. For example, this writer did a study with one of his colleagues (Bricker & Bricker, 1969) in which a group of severely handicapped children were taught to press a button and were reinforced by foods, pop or small trinkets. The rate of button pushing increased predictably, especially when the ratio of responses per reinforcement was increased. This is an example of a primary circular reaction, although Piaget neglects to indicate that interesting consequences can increase the rate of response when delivered on an intermittent, rather than a continuous, schedule of reinforcement. Once rate was reasonably high, a tone was paired with reinforced sessions; when the tone was off, the dispenser of the reinforcers was off as well. Consequently, the child was under extinction in the absence of tone. When the child had not pushed the button for five seconds or more, the tone would be turned on and the dispenser would be reactivated. Eventually, the children in the study pushed the button only in the presence of tone and stopped immediately when the tone was off. Once the children learned to do this, we were able to make systematic changes in both the intensity of the tone and in the frequencies used, until we were able to give the children a very reliable hearing test. Pressing in the presence of tone, and not pressing in the absence of tone is an excellent example of a discriminated performance. It also falls within the definition of a secondary circular reaction. In a behavioristic approach to development, discrimination training is a routine procedure, but in the literature devoted to secondary circular reactions there is little or no information on how to cause a child to shift from primary to secondary forms of circular reaction.

Coordination Of Secondary Schemes

Piaget calls the fourth stage of development the coordination of secondary schemes and states that in this stage we have the "first actually intelligent behavior patterns" (1952, p. 210). Piaget differentiates the third and fourth stages thusly:

> The reactions of the third stage (secondary circular reactions) therefore constitute the simple prolongation of the primary circular reactions; they owe only to their complexity the fact of drawing, after the event, a distinction between transitive and final states, between means and ends. On the other hand, the behavior patterns of the fourth stage involve such a distinction from the very outset. The criterion of their appearance is, in effect, the intercoordination of the secondary schema. Now, in order that two schemata, until then detached, may be coordinated with one another in a single act, the subject must aim to attain an end which is not directly within reach and to put to work, with this intention, the schemata hitherto related to other situations. Thereafter the action no longer functions by simple repetition but by subsuming under the principal schema a more or less long series of transitional schemata. Hence there exists simultaneously the distinction between the end and the means, and the intentional coordination of the schemata. The intelligent act is thus

constituted, which does not limit itself merely to reproducing the interesting results, but to arriving at them due to new combinations. (1952, pp. 210-211).

Here, then, we have finally arrived at a description of cognitive process at its very best. Schemes or schemata indicate the organization discussed earlier. These schemes must persist across time and the behavior cannot be suggested by the nature of the stimulus situation, nor can the coordination itself be a previously trained occurrence. In addition, we have the introduction of the pivotal term in all cognitive development which is intention. The child must intend the outcome of the coordination and be able to operate within the intention in a manner that clearly separates means and ends.

To ascribe a child's behavior to his or her intentions is a commonplace means for overcoming one of the biggest problems confronting our knowledge about complex human behavior. The importance of this concept of the intentional act as the prime determiner of subsequent specific behavioral responses is clearly recognized, but its appropriate use depends on the means that we use to define it. The problem with its use is related to the degree of primacy given to the intentional act in the development of behavior. If intentions can be seen as an outcome of early education, they can be used as processes that are explained by their history of development and can be used as known building blocks in the development of more complex forms of behavior. If they are assumed to exist from the very beginning of an infant's postnatal life, then they become metaphysical blocks to understanding human development.

An excellent means for understanding the difference between the two approaches to intention can be found in several recent investigations which we conducted in our Early Intervention Program. In the first investigation by Levin (Bricker, Macke, Levin & Campbell, 1981) several Down's syndrome toddlers were first taught to push small chairs to a given location in order to get a "desirable" object; the infants also were taught to climb on the chairs in order to retrieve the object. In addition, they were taught to use a string or rake to retrieve an out-of-reach box and receive what was inside. In another setting they were taught to open various types of cardboard boxes. After the infants had met criterion on all schemes (pushing, climbing, pulling and opening) individually, they were put in a situation in which they needed to combine all schemes.

Generalization did not occur immediately. The toddlers needed additional antecedent determinant variations in order to put the four schemes into a fully functional chain. One toddler would push the chair to the cupboard and then sit in it rather than climb on it. Another would climb without pushing the chair to the correct location. However, after two sessions in specific chaining, all met the criterion for success and two toddlers generalized the chain to other situations. From this, one can postulate that intentions are merely flexible chains of previously taught schemes which are limited in generalization to the component structures of the schemes themselves and to the component structures of the situations in which chaining was taught. From the perspective of a non-homunculus position, the child can intend to do only what the component elements of his or her repertoire allow; he or she does not generalize beyond the parameters of what he was previously taught by people or by interactions with the physical environment.

The second investigation (Macke, Simmons, & Bricker 1982) was concerned with Piaget's account of developments in the sensorimotor content area of object permanence. The final form of behavior that is used to define a child's repertoire as having the object permanence concept is the child's use of a systematic search procedure to obtain a needed object that is absent from the immediate environment. In this sense, systematic search is defined as looking in a particular location once and then going on to additional locations until the object is found.

For example, if after removing his or her coat and later being told to find it a child proceeds to search systematically in the locations where he or she was likely to have put it, then we have an intentional act. In this sense, intention is defined as first having a goal (to find the coat) and then using a previously untrained search pattern (looking only where the child was since the shoe was removed and looking in each location only once) to obtain the goal. How the child comes to the point in development where this sequence can occur defines the issue of primacy. What history of interaction with the environment is necessary for the child to be able to search systematically (or is none really needed since this is part of our genetically inherited human competence)?

As described originally by Piaget (1937), the behavioral sequence of object permanence moves through the same hierarchy of stages described earlier. Piaget demonstrated that in the first stage, the young child will begin to reach for an object and then stop the action in mid-reach if the object is suddenly covered with a cloth or other innocuous concealment. The young child reacts as if the withdrawal of the object from direct sense (perceptual) contact "means" that the object no longer exists. The absence of emotional behavior to this withdrawal is the key condition that allows this inference. In effect, out of sight is out of mind. In the next stage of development, the young child will look for an object where it was last found, even though he or she watches the object being hidden in a second location. Later, the young child will seek an object where it was last seen, but will not search systematically for an object that he or she did not observe being hidden. In the final stage, the child will search for an object that he or she did not necessarily see when it was misplaced or hidden, and he or she will do so in successive locations, including new locations as well as those where it was last seen or found. Only in this final stage can we state with confidence that the child is behaving with clear intention. In this stage, the goal exists prior to the selection of the means to attain it, and the means may involve a combination of events that has not been specifically trained.

This sequence of development has been observed in both nonhandicapped (Kramer, Hill & Cohen, 1975; Uzgiris & Hunt, 1975) and handicapped children, with some of the handicapped children being as old as 15 years (Kahn, 1976; Rogers, 1977; Wohlhueter & Sindberg, 1975). Recent evidence (Brassell & Dunst, 1976; Kahn, 1978; Robinson, 1974) indicates that the development of object permanence can be facilitated in severely handicapped children. In a study with preschool age Down's syndrome children, Robinson (1974) demonstrated how training could be used to move children from looking where the object was last found to looking where the object was last seen. Robinson then reversed the contingencies twice to demonstrate that the "strategies" used by these two- and three-year-old Down's syndrome children were under the control of the antecedent and consequence manipulations.

The present writers extended Robinson's research into a more complex form of search behavior in order to demonstrate how a child could be moved from looking for an object where it was last seen to looking for an object systematically when it was not seen hidden. This form of behavior does not occur naturally in the repertoires of young moderately to severely handicapped children and is also considered to be a prerequisite to language use (a primary basis for the occurrence of a request for an absent object). Training systematic search behavior had to be done in a number of different contexts and to be varied systematically in each context before the behavior of the young children became flexible enough to be considered operationally intentional. Thus, intentional behavior can be made to occur, although the outcome is less a product of what the child does than a direct outcome of the teaching of complex behavioral chains that are under the control of subtle and rapidly changing environmental conditions. When we left the children to their own devices, they continued with the same pattern over several consecutive daily sessions. When we then gave them a modeled demonstration of the correct search sequence, they again persisted in using their previous mode of search.

Further Explorations in the Development of Intentional Behavior

The measurement of intentional responding as a consequence of early education can be seen in a study that was just completed in our program. A parent education sequence that used selected chained schemes as the target for each of the children was attempted. The children ranged in age from two to four years with developmental quotients (primarily extrapolated from Bayley Scale scores) ranging from approximately 40 to 90. The initial phase of the study was done with 14 children and their mothers. Seven of the children had been medically diagnosed as Down's syndrome (trisomy 21 in all cases) and the remaining seven as having a variety of problems involving diagnosed indications of brain injury (hydrocephaly, microcephaly, post meningitis or of unknown origin).

The study consisted of three intervention periods during which the parent attempted to teach the child to push a bench to a counter, climb on the bench, pick up and use a rake to obtain a closed box which the child then opened to obtain whatever was placed inside. The second period in each session was used by the parents to teach their child to place a mat, dish, cup and spoon on a small table and, if time permitted, to set a second place for either the mother or a doll placed in a chair by the table. After the place was set, the child was then taught to open a pop-top container to obtain a small amount of solid food and to pour liquid (apple or orange juice) from a pitcher into either one or both cups. The sessions were distributed one week apart.

During this period of time the parents had group sessions with a qualified staff member who covered a sequence of topics including methods for maximizing motivation, arranging the environment to facilitate learning, careful use of physical guidance and demonstrations, and the need to reduce verbal directions and verbal prompts. Following these sessions during the course of each week the parent would meet with the staff member and view the previous week's tape of him or herself working with the child. The interactions were discussed in relation to the week's lecture content in conjunction with the specifics of their own behavior. The tapes were replayed at critical moments to make a particular observation more salient. These individual sessions were repeated five times with a different emphasis each time.

The tapes were rated by the staff members to record the rate of verbal directions, verbal prompts, gestural prompts, demonstrations and guidance and the frequency of apparently positive and negative social and tangible consequences immediately following specific child responses. The behavior of the children in the chained sequences were rated on a component by component basis using a ten point system. Low scores indicated lack of competence and efficiency relative to the child's motor difficulties. The score of 10 indicated maximum competence and efficiency. The ratings took a minimum of six minutes for each minute of taped interaction.

The reliabilities among the raters were reviewed and redefined until all components had agreements among the various raters of above 80 percent. This is one of the clear advantages of using videotapes (as well as two individually controlled cameras and two microphones). The instructional responses of the mothers varied from one component scheme to another according to the competence of their child on that particular scheme. However, when grouped across all schemes, the correlations of their verbal, nonverbal and consequence frequencies from one session to the next were all above .90. The performances of the children from session to session ranged from .79 to .98 depending on the component scheme. Thus, there is assurance that the behavior of the mothers, their young children and the raters was sufficiently consistent to make the outcomes dependably reliable.

The major change that occurred across the sessions was a statistically reliable reduction in the use of the mothers' verbal directions and verbal prompts. While there were substantial

changes in the use of nonverbal instructional activities, such as guidance and gestural prompting, and in the frequency of positive consequences, these were on an individual mother basis; there were no group trends that were statistically reliable. The changes that did occur reflected a correlation between the competence levels of the individual children and the instructional content of the sessions. The mothers of the more competent children demonstrated greater change in the specified direction. Closer analysis of this pattern indicated that the changes in the parents followed the changes in their children rather than the reverse. Thus, the parents of the children who did not change substantially across the sessions tended to continue their customary approaches while those who saw their children changing were more tolerant about experimenting with the new alternatives.

On the first attempt by each child the scores ranged from 5 to 29 out of a possible 40 (10 for each scheme). The second session scores for each child ranged from 16 to 37. In this case, all of the children demonstrated positive gains. An important finding here was that in nine of the eleven cases, the highest score occurred two or more attempts before the last recorded attempt. Generally, the highest score occurred in the fifth or sixth attempt. The data from the table-setting activity show about the same set of relationships although the children had far fewer attempts in that activity and two of the children showed no performance improvements across the sessions.

An interesting finding was that the parents could reduce their verbal directions considerably and not hurt the performance level of the children. In fact, several parents learned that their child would do better when all of the prompts were withdrawn and the child left alone to get the job done. Another finding was that the children who learned to perform a specific act such as pushing, raking or opening did not necessarily comprehend the scheme or concept of that activity. In the opening task, several different boxes were used and each had its own difficulty level. While the rake was placed in several different locations, some children did not use it, but turned to their mother for help when it was not directly in front of them. Additionally, although the children did climb on the bench to get the box, none of the children generalized to using a stool to get items from the cupboard. In other words, they could climb on the bench, but had not yet learned to go and get a climbable object and place it appropriately to get some other, out-of-reach object.

Each of the component forms of behavior in this example were observed in their final form, as well as in their developmental progression. Pushing and climbing increased across time; in their various specific occurrences, pushing and climbing produced a variety of results. In most cases, the outcome of climbing was totally accidental in that items were found after the climb had been made. As the sequence repeated itself several times, however, we could say that climbing came under the control of items that were placed too high to reach without climbing. This control extended to locating and pushing climbable objects in order to get out-of-reach items.

The history of these forms of behavior becomes the explanation of how the child learned to do these coordinated movements. As far as reinforcement is concerned, any consequence can be reinforcing, including whatever consequence a child experiences from climbing or pushing a chair. As this skill improves, other consequences such as climbing only to receive candy, may begin to dominate, while climbing for the sake of climbing may disappear. These are observable relationships on which two or more people can agree. To consider terms such as "purpose" or "intention" adds nothing to the observation that forms the basis for their use in the first place. The issue is not whether the child did something by accident or on purpose, but whether he or she did it and whether he or she is likely to do it again. The role or mission of the behaviorist is not to present explanations of why something did or did not happen, but to manipulate the

child's environment to promote a functional repertoire of behavior and to prevent or reduce behavior that will serve to restrict the child's access to the full range of opportunities. This role might be evaluated best in the following section that deals with practical activities that teachers might use in dealing with those forms of behavior generally considered within the realm of cognitive development.

So What Do We Measure? What Do We Modify?

Not one of the examples presented above involved behavior that was not motivated in some way. Consequently, our first priority is to establish motivational conditions for each child. One place to look is at research that has been done during the past few years with infants. A good example is from the work of John Watson who has coined the phrase "contingency awareness" (Watson, 1971). Watson worked with infants who were about six weeks of age. They were placed in a crib equipped with a mobile about 18 to 20 inches above their eyes. The infant's head was on a double chamber air pillow which would cause a counter to indicate either a right or a left head movement. A reading was taken to determine which side the infant favored. If he or she moved to the right more often than to the left, any movement of the head to the left would cause the mobile to rotate one full revolution; if he or she favored the left side, then any right side movement would activate the mobile. The outcome was interesting in that the majority of infants would quickly shift to the previously nonpreferred side while watching the mobile. Thus, the movement of the mobile was determined to be a motivating condition for six-week-old infants; on the other hand, infants who were shown the mobile move regardless of whether they moved their head to the nonpreferred side, did not later learn to respond to the mobile as a reinforcer by changing their position preference. (This may not be a permanent condition in that infants may eventually learn to make the mobile move if time longer than that used by Watson were allowed.) Thus, infants must learn that a consequence is produced by a particular movement before they will learn that making that movement will increase the number of reinforcing consequences. We will return to this point a little later.

Studies reviewed by Butterfield and Cairns (1974) are of additional interest in this area. In their work with Gary Siperstein they demonstrated that infants would suck on a pacifier with greater intensity to hear vocal music than they would to hear the same music without the singing. Other studies showed that an infant would suck either harder or faster or both to hear a simple "baa" sound delivered again and again on a tape recorder. However, after a while, the infants would slow their sucking rate and intensity to the baseline level as a consequence of boredom, satiation or habituation, but would immediately increase their rate or intensity if even so small a change as "paa" rather than "baa" was presented. Further, other investigators have found that infants will suck harder or faster to hear the pattern of their mother's language rather than to hear the pattern of a different language. These studies are of particular interest for they were done with infants not more than four days of age.

The important point is that motivation is derived from practically any source and is almost unique to each infant child. The search for what works can follow the strong inference model described by Bricker (1976). The starting point is a wide assortment of stimuli that infants or young children can eat, drink, manipulate, look at, listen to or otherwise take interest in. To control conditions in order to see some regularity in the behavior of the student, the stimuli are best presented in pairs in a situation where the child is allowed a clear and easy choice, but in which only one of the two stimuli can be chosen. As the child either reaches for or touches one of the choices, the other is quickly removed, allowing the child to have only the first selection. He or she is then given a reasonable time to eat or manipulate the object for a reasonable

period of time (30 seconds to a couple of minutes is usually sufficient). What he or she does is noted in terms of basic behavior (e.g., "He eats the M&M"). One young girl on whom we used this system always chose small bracelets which she immediately put on her wrists. She never selected foods or other trinkets. This is an example of an extremely stable reaction, in that the item she chose could be metal, a piece of flexible plastic tubing, a small plastic ring or anything else, so long as it resembled a bracelet; the more like a bracelet it was, the better. Other children selected a different object each time, switching from foods, to trinkets, to a small bottle used to indicate a sip of pop. The strong inference model comes into play in terms of specifying the basis of choice on each successive trial. This activity can be not only informative, but also fun for both teacher and child.

In a sequence of trials, prior casual observations of the child can help determine what items should be presented initially. A fruit loop versus a small doll is a potentially interesting contrast. If the child takes the doll and then wipes it on the table, we start with certain guesses. Perhaps the child takes the item which is in a particular position, takes the bigger item, actually prefers the doll or takes the item that wipes better on the table. To begin the test, we pair the "loop" against the doll again, but this time change the left-right position of the two items. If again the child takes the doll and wipes the table with it, we have some evidence that weakens the position hypothesis. One more trial can be used to weaken the position hypothesis still further. On the fourth trial we can substitute a small hand towel for the fruit loop and see what happens. If the towel is bigger and the child chooses it in order to again wipe the table with the item, we might conclude that size and wiping suitability offer the strongest incentives. At this point we can begin contrasting items that don't make good wiping agents, but which do differ in size to check the relative strength of the remaining hypotheses. Given a large plastic stacking cup and a smaller friction car, if the child selects the cup and again wipes the table, we could begin discounting size and concentrate on suitability as a wiping agent. After several trials we might find that the towel was selected over various other items, except when a small amount of pop in a glass was paired with the towel. If on repeated trials the child took the pop regardless of the position of the cup, then we might have two outcomes: wiping is a favorite activity, but pop is a good reinforcer in its own right. We could then go on with other pairings to determine if other elements would be systematically selected and used in various other ways.

Suppose we repeat the procedure with another child and find that on repeated trials the child selects the newly introduced item regardless of the position of the placement and proceeds to use the item in the appropriate manner. For example, the child uses a brush to stroke the hair, places a necklace around the neck and uses a towel to wipe the face. In this case we have a clear indication that the child is operating at the secondary circular reaction level through a string of discriminated performances. Furthermore, the child is tending to prefer the novel, which is a clear indication of tertiary circular reaction performance. Another child might simply select an item, name it and place it aside until a relatively unusual item is presented, if he or she then both selects names and plays appropriately with the item, the child's behavior indicates an even higher level of performance. In such cases, the procedure is used to establish the probable hierarchy of reinforcement, as well as the general functioning level of the child in terms of organized forms of behavior relative to objects.

Once the properties of motivation and basic organization of the student's behavior have been assessed in this way, we then have the capability to assess other forms of organization following the system of measurement described by Dunst (1980) and Uzgiris and Hunt (1975). For example, the girl who spent her time selecting and wearing bracelets could now be assessed in the domains of visual tracking, object permanence, means-ends readiness and the use of

intermediaries. We were able to teach her to use a rake constructed from a hanger to pull a truck to her that had a load of bracelets in the back. She was able, without instruction or help, to pull a towel on which we had placed the rake and then to use the rake to pull the bracelets which we had placed on the other side and out of reach. We are now attempting to teach her how to make her own rakes. In addition, we can now use the situation as a motivating mechanism for instruction in motor imitation, verbal imitation and object naming.

In another example, we were able to determine that a girl in our program would always select items which she could consume. Once she detected food, she would track it in any direction, reach for it and pull a towel with the out-of-reach food placed on top; she would not, however, reach or pull when the object was hidden right in front of her eyes. In the vernacular of Piaget, she did not give us any evidence of the object permanence construct--out of sight was, indeed, out of mind for her, even when we used the highly reinforcing piece of Hershey's chocolate (with almonds, no less).

So what do you do when a child doesn't have the object permanence construct? First, you operationalize the term, and then attempt to teach the targeted skill. In the case of object permanence, the skill involved is searching for an object after seeing it hidden. To teach this, we used plastic tops from coffee cans (not available from commercial educational materials distributors). These lids were an interesting means to achieve our desired end, since a lid that is held gently in place after having food placed under it requires two hands--one to lift the lid and hold it up, the other to retrieve the item. We had to use physical prompting with this child to teach her first to lift the lid and second to bring her other hand into use to pick up the fruit loop. It took approximately fifteen minutes to achieve a criterion of three successive correct manipulations without guidance or other prompting. However, additional instruction was required a couple of hours later when the procedure was repeated. After about four such training sessions, she retained the procedure across the period of a weekend.

This is an example of the test-teach method at its best, and Campbell (Chapter 5, this volume) reports a similar use of the method in the domain of motor training. Another interesting factor was that we had to instruct this child in contingency awareness (Watson and Ramey, 1972), in that it took a large number of trials to teach her to make a bell ring by spinning a wheel before being able to uncover the fruit loop. An even larger number of trials was required to teach her to pick up a block and place it in a container in order to receive an edible reinforcer.

Another example with a different child reflects the issues involved in both the test-teach method and the use of the strong inference model. We were attempting to teach a cerebral palsied child to use a communicator. The communicator was a simple motor driven rotating pointer controlled by a simple switch which the child pressed to start and released to stop. First we taught her to press on command and to release on command. Second, we placed a couple of pictures on the board and then asked her to point to one of the pictures using the device. She would dutifully press the switch and then watch smilingly as the pointer moved right by the desired picture. We used the stop-go training to prompt a correctly timed response which worked by itself, but could not be faded. When no external signal was used, the child continued to press the switch. Systematic attempts at differential reinforcement and prompt timing were used across many trials without success. An attempt was made at classical conditioning using a persistent startle response often emitted by this child. All methods failed until the pointer was taken off the rotating mechanism of the communicator and the child was taught to point manually with the pointer at the named picture. After several minutes of such effort during which she demonstrated ability to point to the named pictures without an error, we returned to training using the switch. With the prompt system we were finally able to get

her to use the switch correctly. However, more than three hours and more than ten hypotheses were used before a solution to the problem was found. The point is that no a priori prescription could have been stated which had a reasonable probability of success; the child's own response often suggested the different hypotheses that were subsequently tested.

Conclusion

The purpose of this paper has been to raise questions about the assessment and modification of cognitive processes of young handicapped children. Although the present description of cognitive development adheres to the basic stages and processes postulated by Piaget, we have emphasized a different set of mechanisms of learning and adaptation than the ones specified by a Piagetian perspective. An attempt has been made to describe the cognitive activities and developments of young handicapped children without major reference to a "homunculus" or to other mentalistic processes.

If we assume that brain damage or chromosomal aberrations hinder the cognitive development of the "mind" when standard practices of child-rearing and education are used, we seek solutions to these problems by initiating alternative and more precisely defined training techniques. Piaget, Chomsky and other cognitivists obviously believe in the "mind", and in this regard we are advised to ignore their position. They have, however, provided a description of the developmental progression that seems to be important relative to a definition of normal behavior.

This progression can be used as terminal-state descriptions by those who believe that complex repertoires are learned and can thereby be taught. In this way, we use Piaget and others to tell us what to teach, and we use the work of Skinner and his many followers to provide the strategies of instruction. Those in contemporary educational and psychological circles who are quick to dismiss Skinner and his colleagues would do well to recall his admonition that we must be patient with the future of our science, collecting each fact carefully. When our facts are sufficient in number and breadth of coverage, we will have the theory that so many others seek prematurely. He went on to say that such a theory would be difficult to understand, but it would not be misunderstood (Skinner, 1950).

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MEASURING MOTOR BEHAVIOR*

Philippa H. Campbell, Karen J. Clegg, & Leslie McFarland

Traditionally, the sequential emergence and increasing complexity of motor behavior have been attributed to the progressive maturation of the central nervous system during the first several years of life (Gesell, 1940). However, more recent theory has looked at the relationship between the environment and maturation to provide an explanation for how the young infant develops more complex motor sequences (Bower, 1979). Despite recent investigations, there is no definitive description of the complex processes through which the young infant learns to sit, walk, manipulate or perform other motor actions.

Gesell (1954) viewed development in motor behavior as a direct expression of central nervous system activity; that is, Gesell believed that behavior was representative of central nervous system complexity at any given point in the developmental process. Therefore, concepts such as cephalo-caudal (head-to-tail) progression, gross to fine or other similar notions were proposed as explanations for the motor behavior observed in infants of varying ages. The detailed descriptions of infant behavior that were developed on the basis of longitudinal studies of infants conducted by Gesell and his co-workers (Gesell, 1939; Gesell & Amatruda, 1947)) provided a description of motor milestone skills and provided the basis for the ages and stages view of motor development. These descriptions outline the basis for most physical and occupational therapy assessments of motor development and underlie the theoretical basis for more formalized assessments of infant development (Bayley, 1969; Frankenburg & Dodds, 1967; Knobloch & Pasmanick, 1966).

Current child development theory indicates that development occurs as a function of genetic expression in combination with learning. Genetic expression (which in itself is influenced by environmental factors) can be used to explain the basic sensory-motor responses that are observed in young infants. Until the time of birth, development is entirely a function of genetic expression within the psychochemical environment inhabited by the infant. After birth, the child's development is a function of genetic expression concomitant to a variety of experiences taking place in a psychological environment. Limitations of movement or in sensory abilities which deprive the infant of experiences or constrain the infant's exploration of the environment can alter the developmental process by restricting genetic expression. For instance, the genetic composition of visual units of genes can be switched "off" if the child is not provided with visual stimulation (or if he or she is unable to receive that stimulation due to severe blindness). The emergence of basic forms of reflexive movements appears to be related to genetic expression, and infant reflexes such as grasping, primary standing or automatic walking represent genetic expressions of behavior that will later be demonstrated by the child as a function of environmental stimuli and problem-solving strategies. The contribution made by maturation appears to be that of the initial genetic expression of a basic motor pattern. The basic motor pattern itself will be altered in complexity as a function of learning that occurs through interaction with environmental stimuli.

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Bower (1979) has summarized the relationships between genetic expression and motor learning:

> The first thing to note is that rates of development are plastic and are completely under environmental control. The differences that can be produced by environmental manipulations far exceed the individual differences that exist in "normal" groups of infants. A second point to note is that severe genetic abnormality does not preclude normal development. Overall development is slowed but the slowing is due to the way the condition isolates the child from normal environmental inputs .... By contrast, specific environmental inputs are necessary (to alter development). (Bower, 1979, p. 175).

Learning is quite different from development in that learning is not related to maturation. Repeated studies have demonstrated that newborns learn from the moment of birth (see Bower, 1977 & 1979 for a fuller discussion of learning related to sensory-motor skills). However, in order to demonstrate that newborns learn, the required response must be within the motor repertoire of the infant. In other words, studies of the learning of young newborns must embrace responses that are compatible with both postural tone and movement patterns that are the result of genetic expression. Because learning relies heavily on the consequences to a response, positive consequences strengthen or increase the preceding motor response and negative consequences or punishment both weaken or extinguish behavior. Thus, theories related to learning can account for changes in rate of development and for the embellishment of basic sensory-motor patterns into complex and coordinated patterns of movement. The implications of applying theories regarding child development to motor behavior are clear and more powerful than those from the Gesellian maturational viewpoint. Though it is evident that motor behavior may be interpreted from both the maturational and environmental perspectives, the implications for therapists and educators altering the course of development of children is that we must be familiar with both perspectives but draw from the environmental perspective to establish the foundation for our intervention. Since our overall objective is, after all, to alter motor behavior and the rates of sensory-motor development, it is essential that we construct an environment conducive to effect these changes. Without an objective of altering motor behavior, the child would be left to develop according to his or her predetermined and maturational course.

Atypical Development

Knowledge of the ages and stages progression of motor milestone skills is useful only when the therapist or educator desires to document the extent to which a given child deviates from the performance of motor skills demonstrated by non-handicapped children. The sequence of motor developments in normal children is cumulative rather than linear (as represented on tests and checklists). In other words, the previous emergence of a skill (such as crawling) may either be related to or a direct antecedent of a later skill (such as walking). However, the antecedents of later motor skills appear to be the earlier reflexive forms of the behavior. One example is automatic walking, an early reflex demonstrated by young infants that apparantly disappears to be replaced later by walking. Limited studies have demonstrated that where the environment is arranged so that a given reflex, such as automatic walking, is "practiced," two results occur: 1) the reflexive form of the behavior does not disappear or become integrated and 2) the more mature form of the pattern occurs at a significantly earlier age than would be expected (Andre-Thomas & Dargassies, 1952).

It is also important for both therapist and educator to understand that development does not appear to follow a necessary sequence. The normal sequence of skill acquisition is significantly altered when sensory or motor processes are biologically impaired. For instance, blind infants do not develop mobility until after auditory-manual (reaching to sound) skill is established (Adelson & Fraiberg, 1974). However, infants born with congenital amputations of the arms develop mobility and locomotor skills without ever developing either reach or grasp. Children with significant hearing impairments may show delays in performance of motor skills as do children born with (or who acquire) deficiencies in postural tone and movement against gravity (such as in Down's syndrome, cerebral palsy, psychomotor retardation and other conditions.) Nevertheless, children in all of these groups may be "normally intelligent" and may demonstrate a variety of cognitive and communication skills without ever having demonstrated normal sensorimotor prerequisite skills. Such cognitive growth indicates that there must be more than one behavioral path to the same developmental end.

The therapist or teacher who is developing skill acquisition objectives for a child with delayed or atypical motor performance on the basis of the ages and stages maturational model may have difficulty when working with children with dysfunctional central nervous systems (such as in cerebral palsy and many genetic conditions). The ages and stages approach implies that the child will demonstrate more complex skills, regardless of environmental influences, as long as the central nervous system matures normally. This oversimplified account of motor development permeates our present understanding of motor processes, while confusing our attempts at early intervention for handicapped children. Models of abnormal development (or what the likely progression of skills is for a given disability without intervention) may be a more useful basis from which to develop goals and objectives related to motor learning. Knowing what to teach or train, though, is only half of the problem. Knowing how to intervene, and with appropriate techniques and methods for a given situation, is the other half. Sequences of abnormal motor development, when combined with techniques derived from applied behavior analysis and therapeutic approaches, can facilitate or enhance acquisition of movement skills as well as provide the basis for measurement of progress in motor skills (Campbell, in press-a & b).

Sequence of Atypical Motor Development

Many very young infants who have genetic or chromosomal abnormalities, and/or children who have delayed or dysfunctional central nervous systems have difficulties with postural tone. Postural tone is the degree of tension in the muscles and provides the basis for performance of automatic and goal-directed movements. All movements consist of two general components--stability and mobility. Postural stability results from co-contraction of muscles to hold or "fix" against the influences of gravity. Thus, the muscles around the neck and head co-contract to allow for fixation of the head against gravity; this fixation is generally referred to as head control. Mobility results from active contraction of muscles, some of which are prime movers for a particular action and some of which are accessory or synergistic movers. Groups of muscles, in coordination with each other, contract to move the bones of the body in various actions. Muscles that oppose those that are contracting for movement must lengthen while the contracting muscles are shortening; for instance, if the biceps muscle contracts (shortens) to flex (bend) the elbow, the triceps muscle must lengthen. Most functional movements (whether automatic or goal-directed) result from an interplay between stability and mobility. For instance, the muscles of the head and neck must co-contract for stability against gravity while still allowing sufficient mobility for head movements to occur. Where postural tone is atypical, both co-contraction (for stability) and contraction (for mobility) will also be deficient.

Because of environmental influences, atypical postural fixations (that compensate for lack of sufficient co-contraction of the muscles) may replace the normal fixation provided by normal muscle co-contraction. Postural fixations that replace sufficient co-contraction may limit or severely restrict normal mobility, resulting in development of compensatory movement patterns. Compensatory movement patterns may become strengthened through both reinforcement (consequences) and practice, producing secondary changes in the muscles. Some muscles may become tight (difficult to move through full range of motion), whereas others may become lengthened and "less elastic" by being maintained in excessive ranges of motion. Tightnesses or elongations may become permanent resulting in altered ranges of active and passive movement. In addition, some muscles may through disuse become weak or atrophied; deformities of joints may also result.

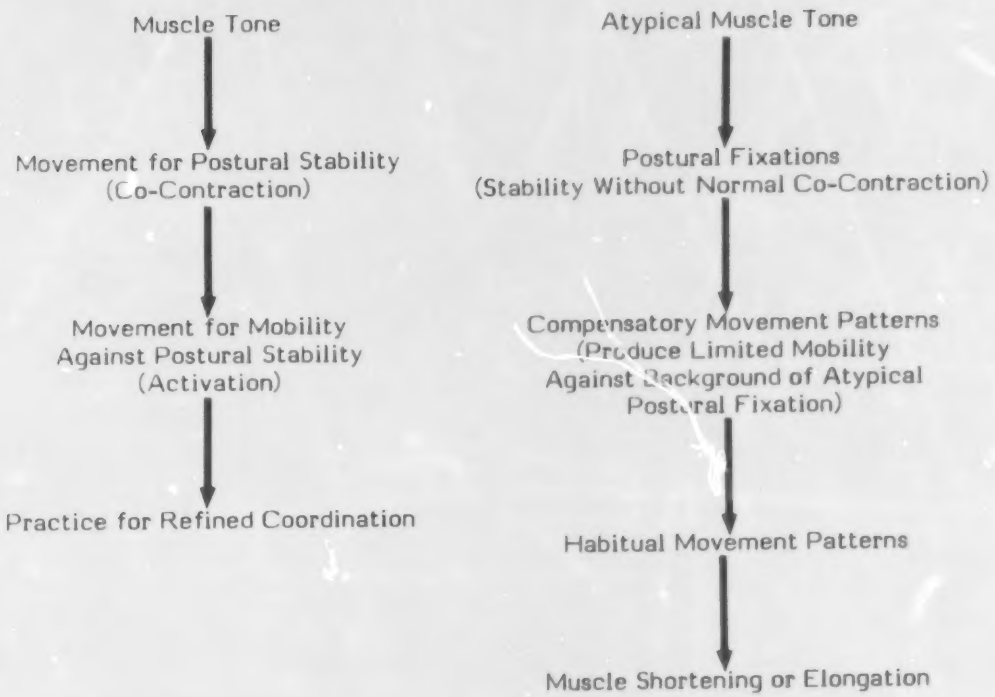
Figure 1 outlines the sequence of abnormal motor development in contrast to normal movement. Goals and objectives for movement skills can be generated from this model where the viewpoint is to prevent the sequence likely to occur without intervention geared to movement processes. For instance, goals to maintain normal range of motion or to inhibit compensatory movement patterns and replace those patterns with more normal movement coordinations or to instate more normal co-contraction of muscles for postural stability provide movement objectives that can be easily embedded in functional skills and accurately measured.

Measuring Acquisition of Motor Milestone Skills

Traditionally, acquisition of motor skills has been measured through standardized and criterion-referenced assessments that are administered on a fixed interval basis of every six or twelve months (Cohen, Gross, & Haring, 1976; Hanson, 1977; Sanford, 1974; Shearer & Shearer, 1974; White, 1982). Any of these devices are sufficient for measuring attainment of milestone skills but are insufficient when used to establish initial and long range objectives leading to competence in movement. Such devices do not constitute accurate measures of all factors pertinent to movement and delete critical components such as postural tone and patterns of movement. Furthermore, since many of these devices are based on the maturational perspective, environmental factors, such as motivation, are not included (Bricker, Macke, Levin, & Campbell, 1981). In addition, programming based on results of milestone skill acquisition is likely to restrict the forms of behavior that are targeted with a given child as well as to imply a necessary sequence of teaching skills that may not be appropriate given each child's patterns of biological deficits.

The rationale behind measuring child motor behavior dictates the measurement system most appropriate for that purpose. Physicians, for instance, measure the neurological behavior of infants and children to identify the appropriate diagnostic label for the motor deficit. However, Touwen (1976) concludes that a successful examination of neurological and developmental factors has not yet been developed. He presents a concise review of the procedures most typically utilized by physicians (and therapists) to assess the integreties of the young child's maturing central nervous system and advocates separation of the neurological and developmental processes. Such an approach has been attempted by Milani-Comparetti and Giadoni (1967a; 1967b), who developed an assessment system whereby the neurological processes and their progressive development are assessed separately from acquisition of motor milestone skills. Evoked measurements of reflexive forms of behavior and automatic movement patterns which right the body in space or maintain balance are evaluated in isolation from spontaneous motor milestone skills. More recently, Wolanski and Zdansak-Bricken (1973) have described an evaluation approach that assesses neuromuscular systems through observation of behavior in four separate domains (movements of head and trunk, sitting, standing, and locomotion), each of

Figure 1
Sequence of Motor Development



which is believed to represent a separate neurological system. Both methods extend the typical assessment of motor milestone skills by adding items related to reflexive and automatic movement. The Neonatal Behavioral Assessment Scale (Brazelton, 1973) takes a similar approach to assess the overall behavior responses of very young infants.

The assessment of motor milestone skill acquisition may be a part of a total evaluation of the child's developmental status for the purpose of determining a current functioning level as well as to "predict" future success. Rates of skill acquisition can be determined based on past performance and can be used to determine the likely rate of future development. These measurement systems have also been used to document the effectiveness of early intervention on skill acquisition of children with various types of handicapping conditions. However, many professionals become critical of the assessment device when re-assessment does not indicate progress on the part of very severely handicapped children. Furthermore, many professionals such as physical and occupational therapists who are providing programming for motor competence, become frustrated when assessment results do not indicate changes in postural tone or the quality of coordinated movement patterns.

Operationalizing Descriptions of Behavior

Where deficiencies in neuromuscular integreties of postural tone, stability and mobility are present, measuring only acquisition of motor milestone skills can be both frustrating and misleading. An example from the Bayley Scales of Infant Development (Bayley, 1969) illustrates this point:

> Stands up by furniture: Observe the child while he is in the playpen or on the floor. Note whether the unaided child pulls himself to a standing position by using a chair, rail, or other convenient object. A toy placed out of reach on the chair or pen rail may be used as an incentive.
> Credit if the child raises himself to a standing position, using the chair or other convenient object for support. (p. 89)

Does the child with hypertonus (high tone) who raises himself to a standing position by becoming stiffer in the legs, pulling only with his arms not using movement of the legs, and scissoring his legs receive credit for acquisition of this skill? Does the child who will only pull up to standing to receive one particular toy (but no other) pass this item? Is performance of the child who pulls up only one time different from that of the child who repeatedly pulls to stand? Is a one time demonstration of the skill sufficient to pass the child on any given item? The answers to any of these questions are unknown but likely to be related to the examiner's perception of the test item itself, as well as to overall general attitudes concerning test administration and evaluation of motor functions.

One approach that has been taken to remediate difficulties with accurate measurement has been to describe skills in smaller and smaller steps of acquisition (e.g. Uniform Performance Assessment Scale, White, 1982). Another approach has advocated measuring more precise aspects surrounding demonstration of the skill (Guess, Rues, Warren, & Lyon, 1980) thus alleviating some of the problems with nonstandard criteria for success that are inherent in motor milestone measurement scales. A concise operational definition of "stands up by furniture" can specify the desired motor response as well as define the criteria against which occurrence of the behavior will be judged. This item might by operationalized as:

Stands up by furniture: Note whether the unaided child pulls himself to standing by grasping the chair or rail with his arms and, using a progression in the lower extremities where he raises himself to his knees, shifts his weight, frees one leg, places it into a half-kneel position, shifts his weight onto the bent leg and stands up by extending the bent leg and using his arms for support rather than for pulling.

Such an operational definition of standing up by furniture approximates the typical sequence of movement patterns utilized by a nonhandicapped infant, but remains insufficient in fully describing the movement components that become sequenced to produce this motor outcome. We still might ask questions such as, "How much flexion should the child have in the bent leg?" Or we might become even more precise and ask, "How many degrees of flexion should the child have at the hip of the bent leg or at the knee of that same leg?" Or "How many degrees of external rotation are acceptable at the hip when pulling to standing?" However, measurements of postural tone, fixation for stability and degrees of mobility of the limbs would still be missing--no matter how precisely the behavior outcome was operationalized.

Operational descriptions of motor behavior assume that outcome behavior can be precisely enough described to differentiate degrees of competence in underlying movement processes related to postural tone, stability/mobility and sequenced patterns of muscular actions. A second assumption is that operationalization of outcome behavior will have some relationship to intervention strategies. A third and very critical assumption is that children with motor impairment and deficiencies in postural tone and movement coordination can perform an outcome skill with exactly the same form of response as that demonstrated by nonhandicapped children and that the form represents attainment of the same postural tone and muscular sufficiencies possessed by the nonhandicapped child.

Collecting Data on Motor Behavior

The most sophisticated and accurate method of collecting data on motor behavior is through either video-tape computerized measurement or high speed film analysis (Sutherland et al., 1981). Only with computer models can the complexity of interrelationships between muscular contractions be accurately recorded and understood. However, the average clinician or teacher does not have access to sophisticated equipment and is forced into measuring movement skills with less than precise systems that depend directly on visual observation of behavior. Nonetheless, some measurements of movement can be fairly generally and reliably made (see Campbell, in press-a).

An initial decision that must be made by the teacher or therapist is whether to attempt to measure behavior outcome (milestone skills), underlying processes to movement (postural tone, postural stability, movement patterns), or both simultaneously. For children with minimal discrepancies in postural tone, measurement of milestone skills with attention to the ways in which the child performs the skills may be sufficient. However, for the child with cerebral palsy or one of the genetic syndromes producing significant deviance in tone, measurement systems reflecting change in the underlying processes may be more effective. Operationalizing definitions of motor milestone skills sufficiently for children with significant discrepancies may become so burdensome as to be unwieldy.

Measurement of Outcome Skills

In essence, measurement of acquisition of motor milestone skills can occur by operationalizing the expected motor response so that reliable measurements can be made on a day to day basis. For instance, an objective of head control in the prone position should be

further defined to state whether head lifting, maintaining the head in prone, or both are the expected motor response. An objective, for instance, for head lifting might read:

> Billy will raise his head when positioned prone over a wedge and with the head in midline position.

Even this objective could be further operationalized to state some of the required patterns of movement:

> Billy will raise his head when positioned prone over a wedge using contraction of the neck extensors but without using neck hyperextension.

However, to operationalize the definition past this degree of specificity may severely complicate the measurement of performance. For instance,

> Billy will raise his head when positioned prone over the wedge with the wedge providing support at the nipple line. Weight will be equally distributed on the forearms and postural tone will be normalized. Head raising will be performed with symmetrical contraction of the neck extensors and flexors and without using shoulder elevation or contraction of the pectoralis muscles to assist in the movement.

Such specificity in defining the expected motor outcome begins to include attention to the underlying movement processes of tone, stability and patterns of movement. The teacher or therapist, though, who attempts to measure frequency of head raising under these response conditions has a great deal of detail to attend to for each time the movement is performed. The assumption in measurement is that if the student does not perform any aspect of the required response that the response is measured as absent (or approximation can be used). Only when all components of the response are demonstrated would the response be counted as present. Such specificity, while possible, increases difficulty in obtaining reliability over time as well as inter-rater reliability.

Table 1 is an example of a data sheet used to record performance under similar conditions of specificity. By presenting basic and required components in check sheet form, the rater is able to check off the presence or absence of each required component for each performance. However, the overall onerousness of such a system would suggest that where more than three components of a required response are stated, measurement systems focussing on underlying movement processes are probably more appropriate and feasible.

Counting (frequency) a particular movement form or counting that response within a fixed period of time (rate or adjusted rate) are the two basic measurement systems used for outcome behavior. Duration, or measuring the length of time a particular response occurs, is another system that is often used. Once the teacher or therapist has decided on the expected motor response, the measurement system that best represents that behavior must be selected. Movements in the acquisition phase can be represented by frequency of rate measurements where those responses require performance of active movement. Figures 2 and 3 illustrate performance measured under these conditions. However, some motor programs are best measured within specific conditions. For instance, numbers of steps taken, distance walked, degrees of joint movement, or pounds of pressure are examples of more specific variables that can be measured in motor programming (see Figures 4, 5, & 6).

TABLE 1

Table I
Gravity Eliminated Lower Trunk and Femoral Extension

Starting Position — Date					
Sidelying, head on support					
Head not out of midline					
No head/neck hyperextension					
Head/neck not out of line with trunk					
No shoulder elevation					
Upper extremities relaxed on floor					
No forward/backward trunk deviation					
No trunk asymmetry					
No forward/backward pelvic deviation					
No pelvic asymmetry					
Hips flexed no less than 90 degrees					
Knees flexed no less than 90 degrees					
Lower extremity supported in neutral plane					
No increased muscle tone					

Stimulus: _____

Position of Stimulus: _____

General Movement Requested: _____

Required Response — Date					
Sidelying head on support					
Head not out of midline					
No head/neck hyperextension					
Head/neck not out of line with trunk					
No shoulder elevation					
Upper extremities relaxed on floor					
No forward/backward trunk deviation					
No trunk asymmetry					
No forward/backward pelvic deviation					
Hip flexed no less than 90 degrees					
Hip extended beyond neutral					
Knees flexed no less than 90 degrees					
Lower extremity not off support					
No increased muscle tone					

Ultimate Functional Goals: _____

_____

_____

Comments: _____

_____

_____

Figure 2
Rate per Minute of Head Movements:
Normal and Hyperextension

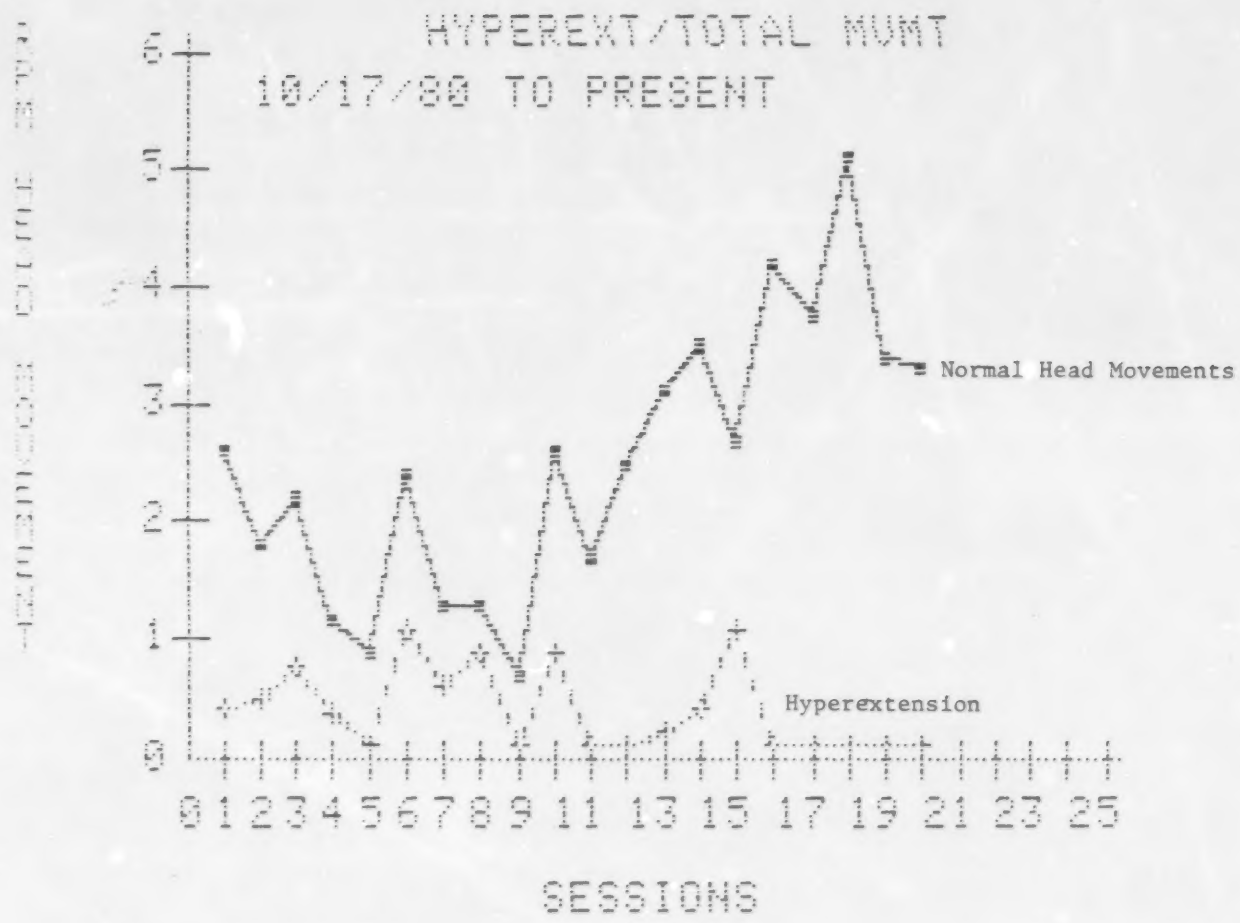


Figure 3
Percent Correct on Fixed Number of Trials:
Eye Pointing to Visual Stimuli

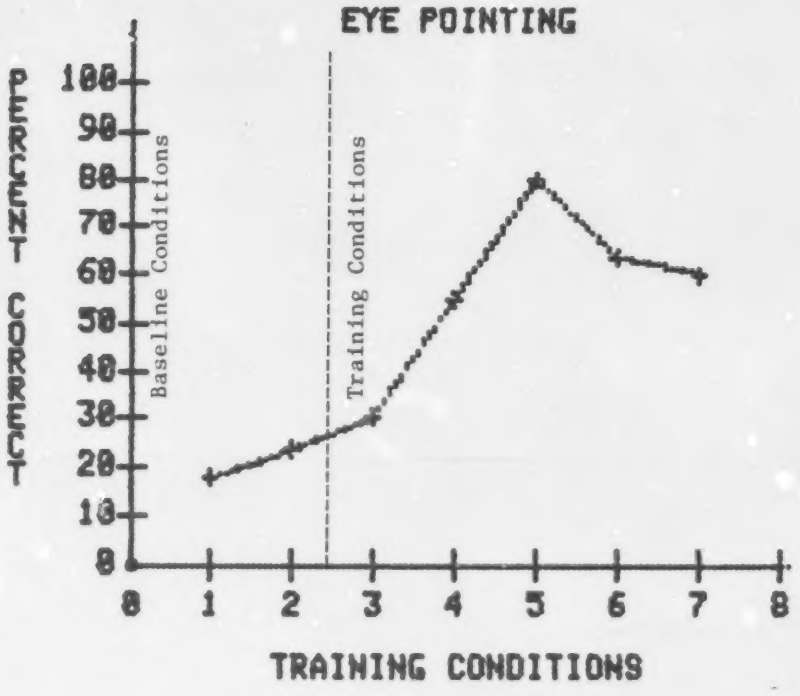


Figure 4
Steps Taken over Five-Minutes:
Independent Walking Holding Support Rail

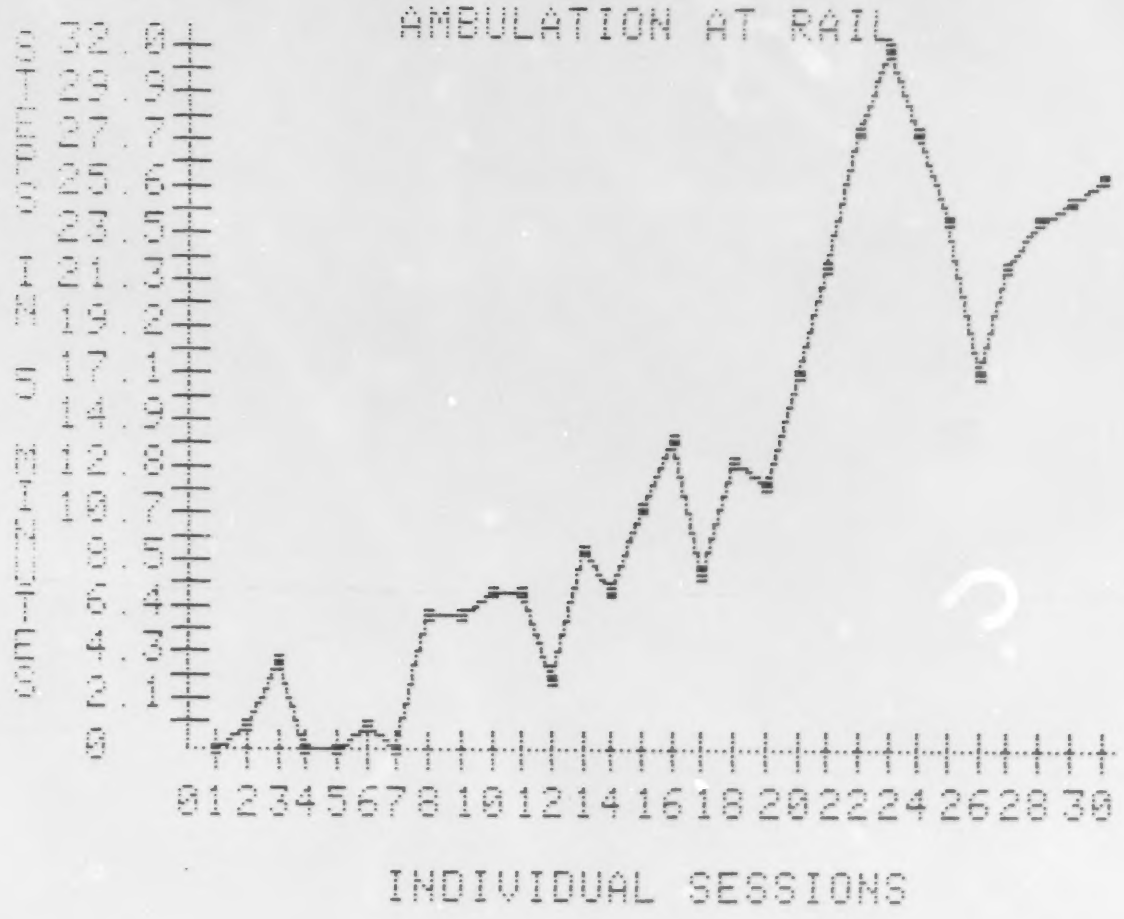


Figure 5
Degrees of Hip Extension: Erect Kneeling

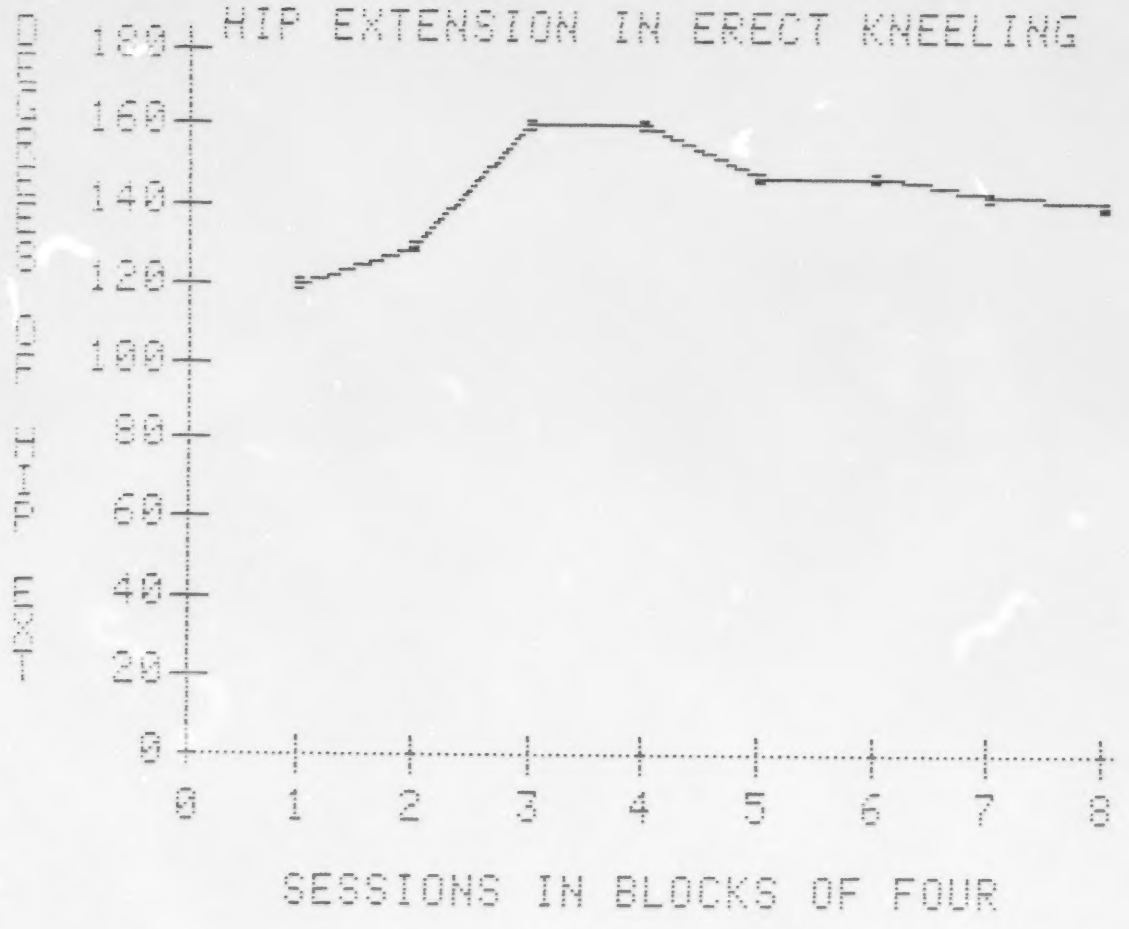
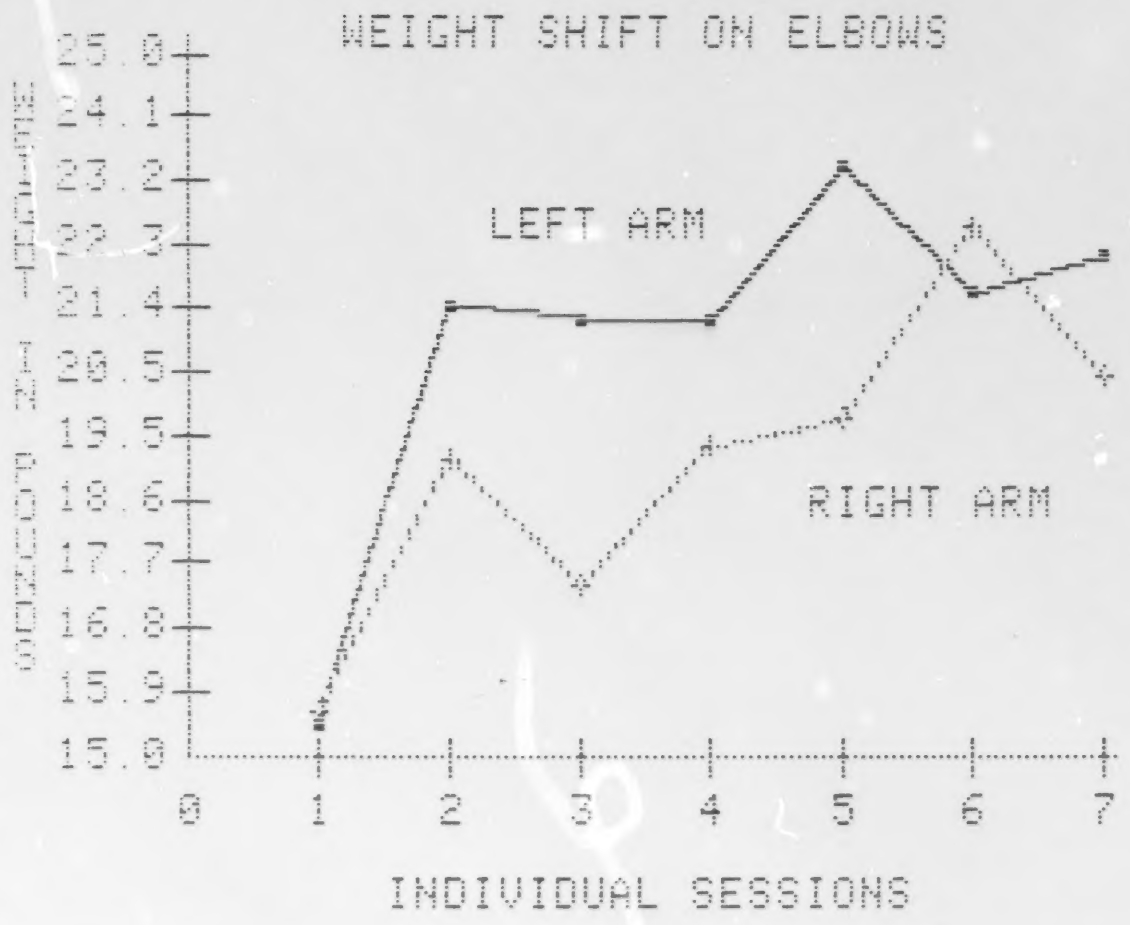


Figure 6
Pressure Exerted on Each Arm
When Shifting Weight from Arm to Arm



Duration measures are more appropriate for expected outcomes that are not achieved through active movement and are more reflective of postural stability. Maintaining the head in an upright position, standing, grasping and other similar forms of behavior are more accurately measured through duration, whereas head raising, reaching for an object, activating a switch or putting a spoon in the mouth are better represented through frequency or rate measures (see Figure 7).

The measurement system selected will reflect not only performance of the desired outcome response but also the conditions under which that response is performed. Measurements that are taken on a day to day basis under different conditions may be unstable and an inaccurate reflection of child performance. Intentional (or unintentional) changes in consequences provided for correct performance (see Figure 8) or inconsistency in programming among programmers (see Figure 9) can significantly influence rate of acquisition.

Many motor responses are acquired under antecedent conditions of physical guidance or therapeutic facilitation techniques. Expected motor outcome responses should be only measured in their fully independent forms--without cues, without physical guidance, and with minimal verbal direction. Ideally, performance should occur in response to natural environmental antecedent conditions so that the child, for instance, reaches for the toy when it is placed in front of him or her--not when told to do so or physically guided to do so. Fading guidance when used as a method of instruction can often be extremely difficult. In the application of some therapeutic methods that are dependent on facilitation as a form of guidance, the facilitation is not gradually faded but may be implemented in an all-or-none fashion. Figure 10 illustrates a program that was carried out with a severely motorically impaired child to train movement of the upper extremity to contact an object placed in front of the child on the tray. The sequence used to fade the guidance to fully independent responses is represented visually by the graph.

Most outcome data that is collected in relation to motor data numerically describes the child's performance under various conditions of instruction (antecedents and consequences). Data collection can also be used to check for generalization or to verify further changed performance through use of multiple baseline or reversal designs. Many questions concerning the right conditions of instruction or the most beneficial positioning for a particular child can be solved by collecting data and representing performance under varying conditions. Figure 11 represents five days of data collected on head movements in both the supine and the sitting positions. This data is interesting in that training for head movements was done only in the supine position (partly elevated) in order to train under the easiest conditions (i.e. gravity assisted). This child's performance clearly generalized to the sitting position (with the head supported) and, in fact, was significantly better in the sitting than in the supine condition. The child was six years old at the time this therapeutic program was implemented, and although definite reasons to account for his performance are not known, the upright posture was perhaps more motivating than the supine.

Figure 12 illustrates data collected in one 18-minute session with an eight month old when interesting consequences were made contingent to movement of the left arm. Leg movements were not consequated and showed a decrease in number in comparison to an increased rate of left arm movement. This graph illustrates multiple baseline procedures in relation to increasing movement. Reversal designs (see Figure 13) can also be used to determine the effectiveness of various conditions of instruction. However, in some instances, this procedure, which requires removing the conditions surrounding performance, is not as applicable with motor behavior, particularly if the response being acquired is a component of a more complexly organized motor response.

Figure 7
Duration of Upright Head Control:
Contingent on Music, Positioning within a 35 degree Arc

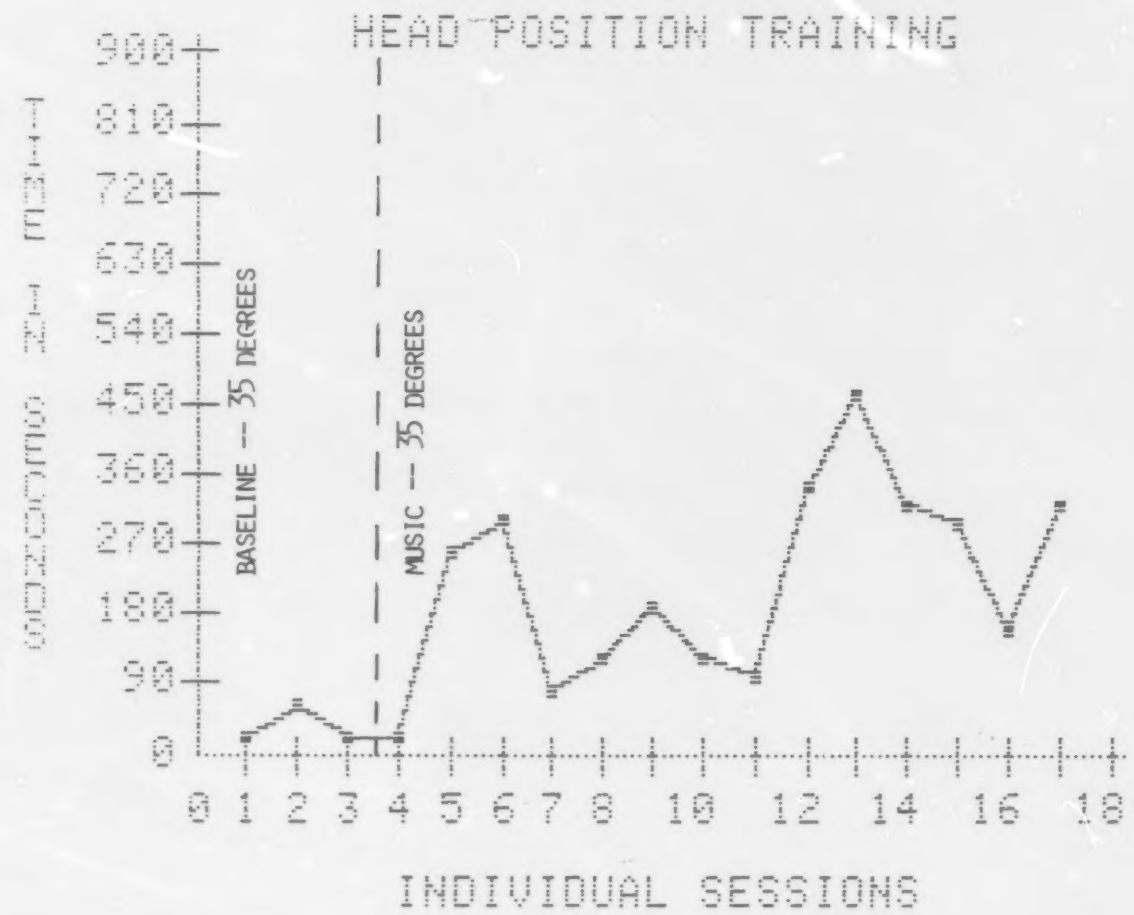
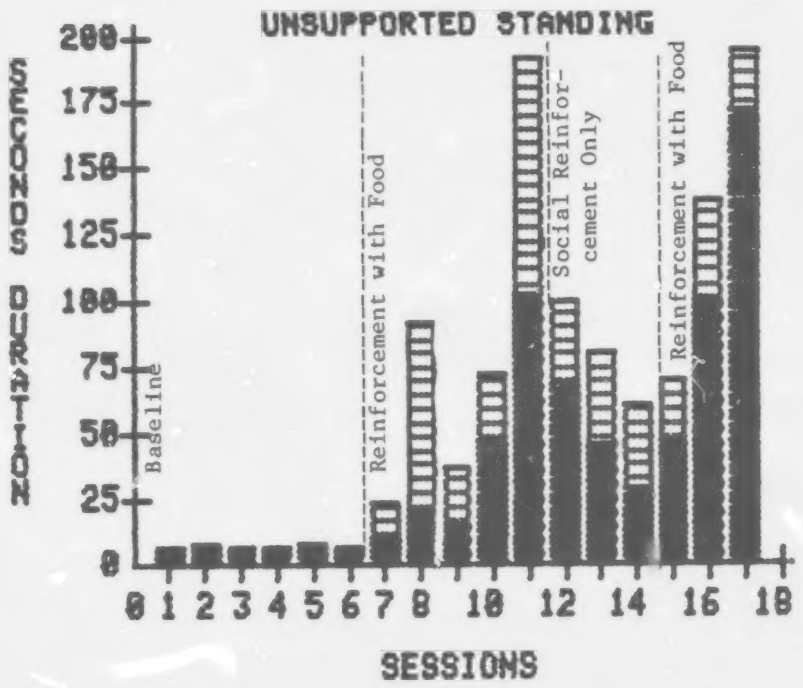

HEAD POSITION TRAINING
BASELINE -- 35 DEGREES
MUSIC -- 35 DEGREES
0 90 180 270 360 450 540 630 720 810 900
0 1 2 3 4 5 6 7 8 10 12 14 16 18
INDIVIDUAL SESSIONS

Figure 8
Effect of Consequences on Standing



Hatched = Longest duration of standing on any of 10 trials
Soilid = Average duration of standing across 10 trials

Figure 9
Performance Staff Programmed from Written Directions:
Before and After Staff Performance Validated by Physical Therapist

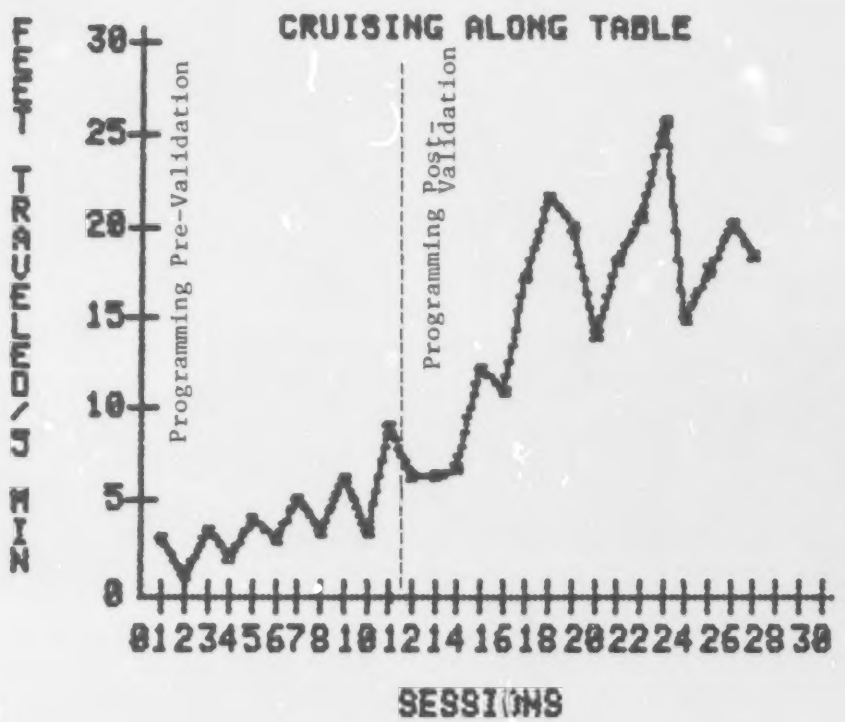


Figure 10
Training Sequence for Upper Extremity Movement
to Contact Object

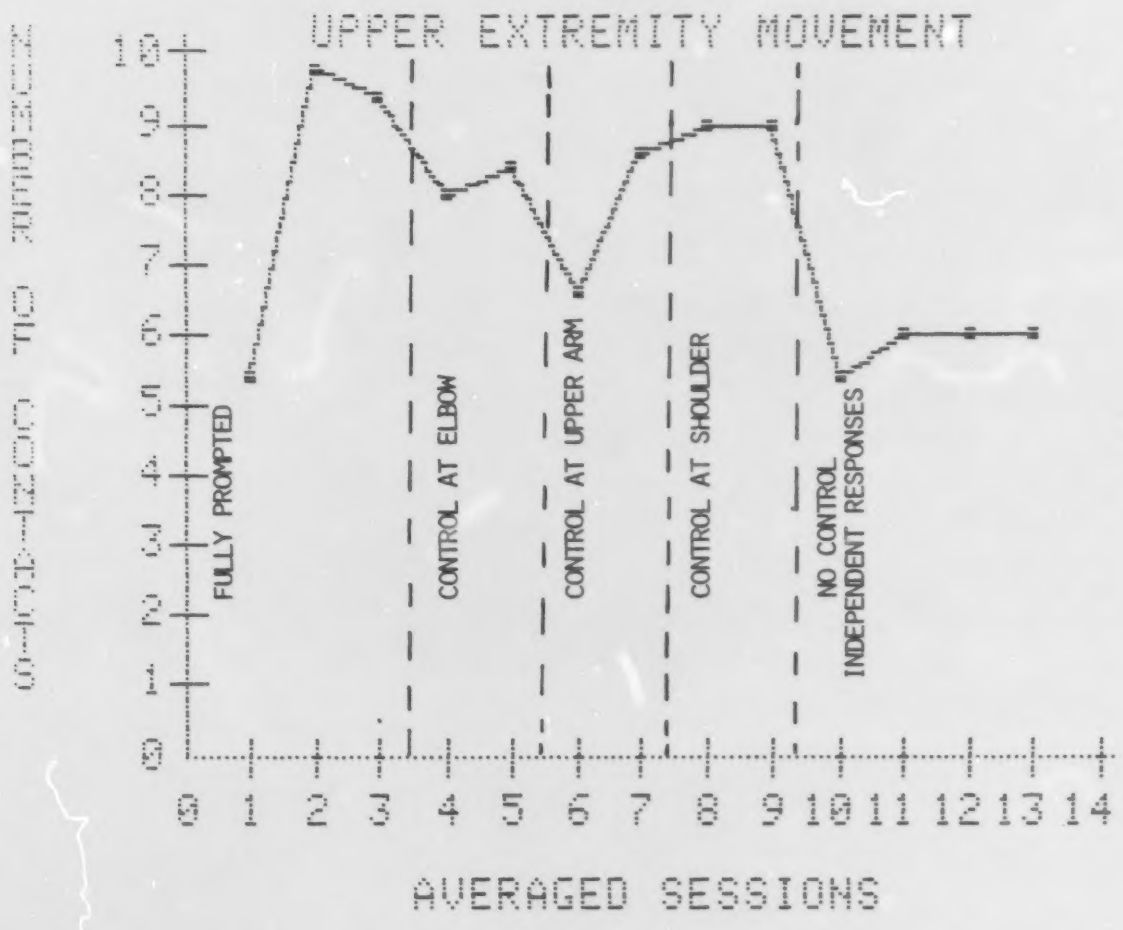

UPPER EXTREMITY MOVEMENT
0-4 CORRECT TO 10 RESPONSES
0 1 2 3 4 5 6 7 8 9 10
FULLY PROMPTED
CONTROL AT ELBOW
CONTROL AT UPPER ARM
CONTROL AT SHOULDER
NO CONTROL
INDEPENDENT RESPONSES
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
AVERAGED SESSIONS

Figure 11
Generalization of Head Movement Training
in Supine to Head Movement in Sitting
with Support to the Occiput

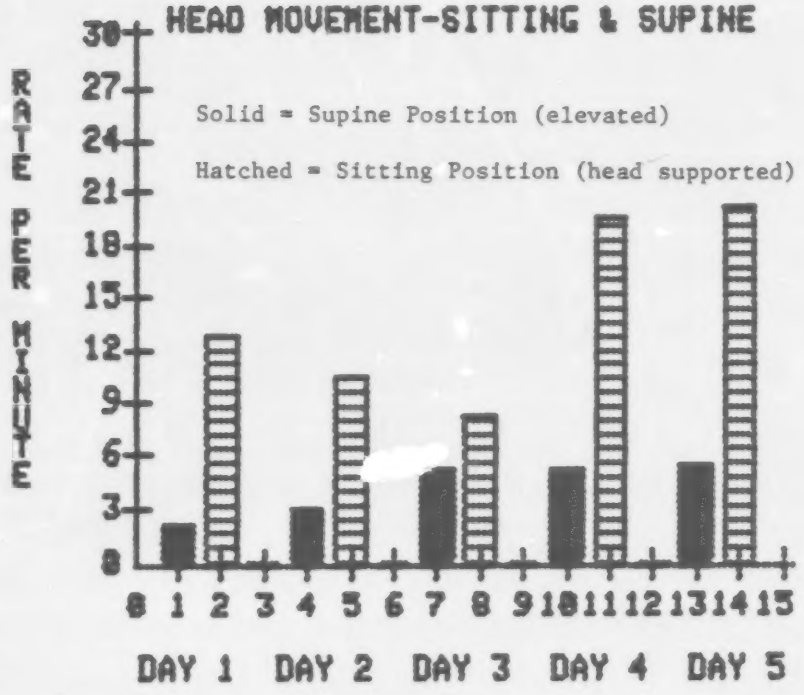


Figure 12
Increasing Left Arm Movement
By Consequating Movement with Novel Outcomes

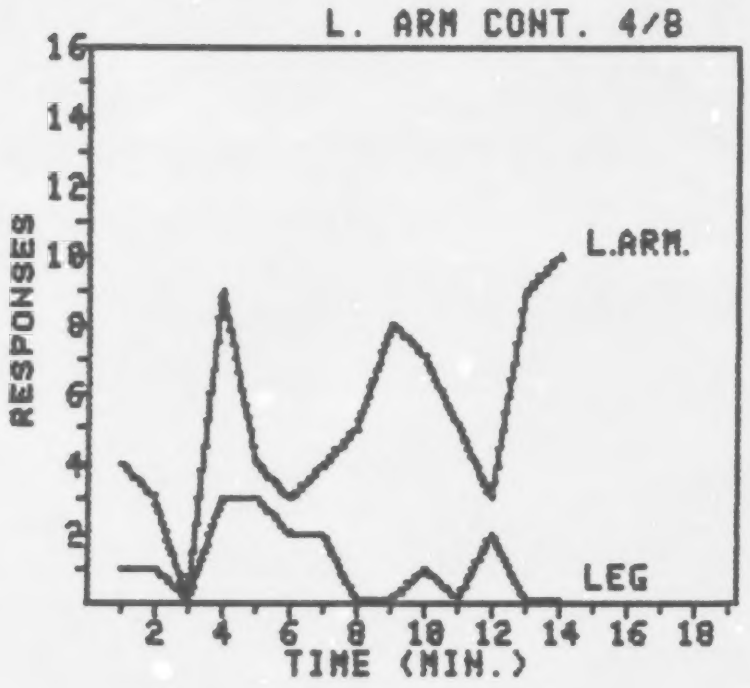
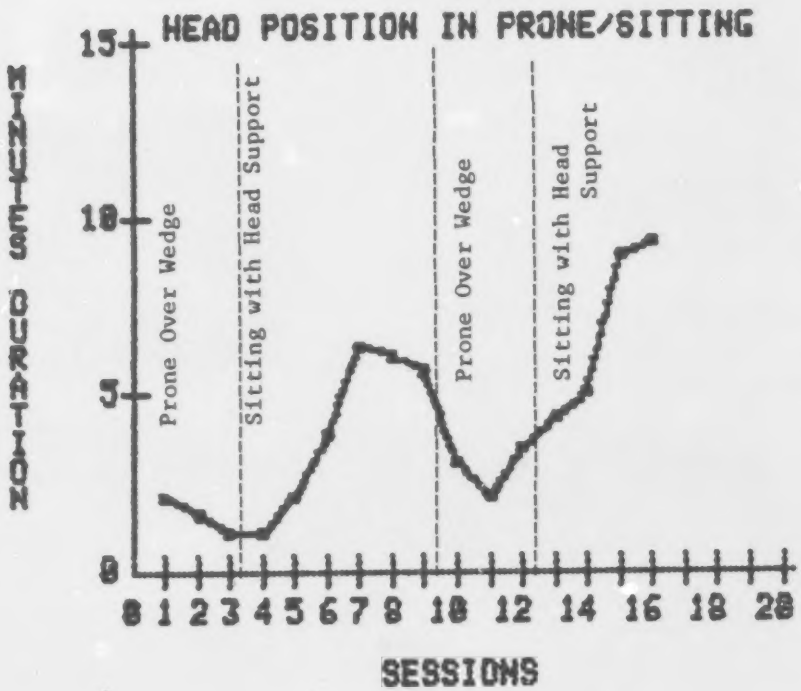


Figure 13
ABAB Reversal Design: Duration of Maintaining Head Upright in Prone and Supported Sitting



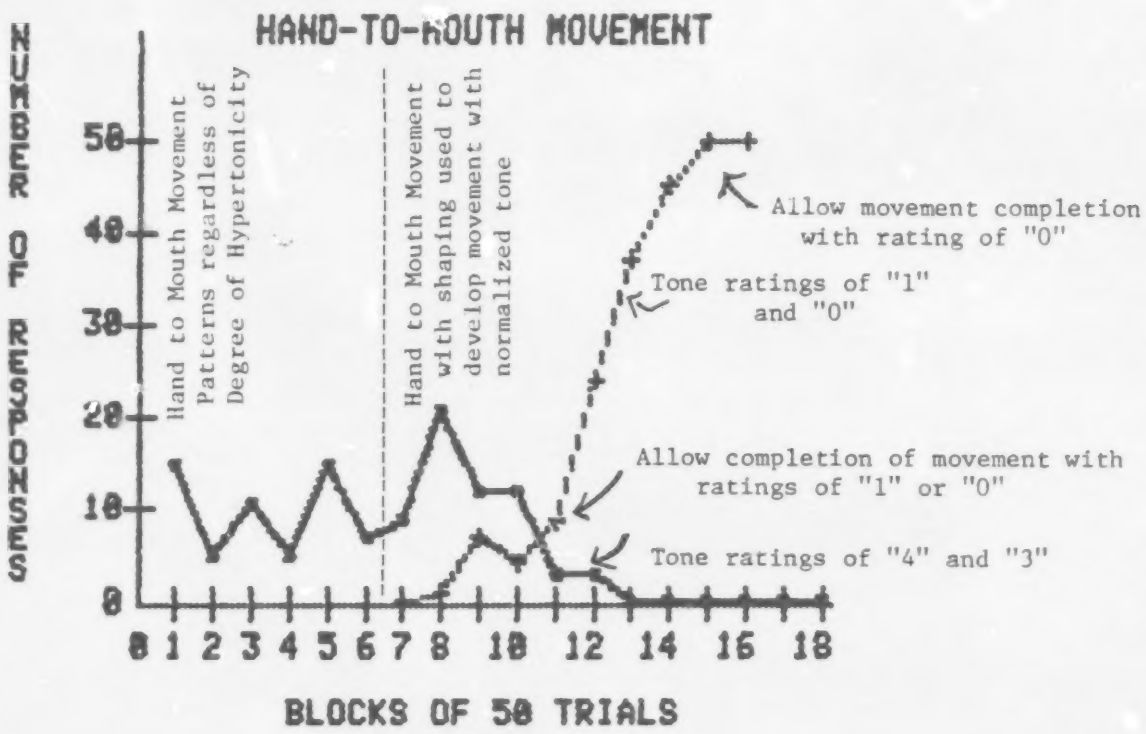
Measuring outcome skills can easily be done within a classroom and provides a mechanism for monitoring acquisition and maintenance of motor skills as well as for determining best intervention practices. In addition, differences in programming between trainers can often be detected by reviewing data. In educational programs where physical and occupational therapists function as consultants to classroom teachers and where teachers are expected to implement programming designed by therapists, ongoing data provides an easy way for the therapist to monitor the effectiveness of the "prescribed" intervention. However, where a number of variables must be considered to determine an appropriate/inappropriate response or where postural tone and movement quality are significant aspects of the expected response, other systems that more directly reflect change in the underlying motor processes may be more useful.

Measurement of Underlying Motor Processes

Postural tone and the form (quality) of the movement pattern demonstrated for postural stability and for active movement are two critical aspects of movement that are extremely difficult to measure. At present, no instrument to measure postural tone directly is available. Therefore, all measurements of tone must be inferred from either EMG recordings or from "feel." To date, clinical assessment of postural tone is as accurate as any other available method (Bobath, 1978). However, ratings for the degree of tonicity present can be made (Bricker & Campbell, 1980; Campbell & Bricker, 1982; Campbell, in press-a), and these ratings can be incorporated into specific instructional programs through operational definitions of behavior during the programming. Figure 14 illustrates a self-feeding program undertaken with a three-year-old child with severe tone fluctuations where tone increased from fairly low (hypotonic) to high (hypertonic) in the shoulders on initiation of movement. Ratings of from 0 to 4 were used to operationalize the amount of hypertonicity present and were indicated for each attempt to put the spoon in the mouth. In addition, these ratings were used to shape hand-to-mouth movement under conditions of normal tone by preventing the spoon from coming to the mouth when postural tone was high. Food was a high motivator for this child, and therefore normal movement with normal tone was strengthened. Similar rating systems and intervention procedures can technically be implemented with any type of movement that is to be increased. If programming is undertaken by more than one trainer, however, inter-rater reliabilities on tone rating must be clearly established before ratings are used as the basis for shaping more normal tone. Recognition of differences in degree of postural tone can be an extremely difficult discrimination, thus causing extreme difficulties in obtaining agreements on tone ratings.

Patterns of movement, whether "normal" or "atypical," performed for postural stability or for active automatic or goal-directed movement, are determined on the basis of visual discrimination. Therefore, the same difficulties that can occur in obtaining inter-rater agreement on postural tone exist with evaluating patterns of movement. Computerized analysis of movement patterns (Sutherland et al., 1981; Plagenhoef, Note 1) using either video-tape or highspeed movie film offers the only truly accurate method to quantify observations on the quality of movement. The therapist or teacher who has access either to home movie equipment or to video-tape can use pictoral samples of movement both to increase accuracy in observation or discrimination and to maintain longitudinal records of child performance. For instance, assessments of movement quality can be conducted on a pre-/posttest basis by taping the child's performance before and after an intervention session. These tapes may be produced once weekly or once monthly (behavior probe) or on a fixed time interval (e.g. every

Figure 14
Procedures to Shape Normal Tone and Patterns of Movement
of the Upper Extremity: Hand to Mouth Pattern


HAND-TO-MOUTH MOVEMENT
SPASTICITY TO AMBIENT
50
40
30
20
10
0
Hand to Mouth Movement Patterns regardless of Degree of Hypertonicity
Hand to Mouth Movement with shaping used to develop movement with normalized tone
Allow movement completion with rating of "0"
Tone ratings of "1" and "0"
Allow completion of movement with ratings of "1" or "0"
Tone ratings of "4" and "3"
0 1 2 3 4 5 6 7 8 10 12 14 16 18
BLOCKS OF 50 TRIALS

Tone Ratings:

4= Increased tone with scapular adduction, elbow flexion, shoulder elevation
3= Increased tone in elbow and shoulder
2= Increased tone in shoulder only
1= Normal tone with inhibition through the right arm/shoulder, hand-to-mouth movement with left arm
0= Normal tone without physical guidance

six months). Movement can then be operationally defined in relation to a particular pattern (e.g. degree of atypical postural fixation at the head as indicated by the extent of shoulder elevation) and rated from the taped behavior samples.

Accuracy of discrimination can be enhanced either by filming or taping the performance against a fixed standard or by applying that standard to the television screen. A transparency with a protractor drawn on it can be applied to the television screen to increase accuracy in determining midline position of the head (degree of lateral flexion of the neck musculature), or a child can be filmed against a larger protractor to operationalize measurements of other movements such as degree of shoulder abduction/adduction or of lateral flexion in the trunk. Methods to increase accuracy of observation and therefore of inter-rater reliability when making judgments about movement patterns are limited only by the creativity of the therapist or teacher.

Traditionally, descriptive accounts of movement quality have formed the basis for documenting improvement in movement quality. The disadvantages of this type of data collection are that the critical observations may not be recorded and the measures of motor performance are highly subjective and based on one person's observation at a moment in time. Descriptions of the environmental or instructional conditions (antecedents and consequences) are often absent from descriptive accounts even though these factors have significant impact on both the performance of movement and the intervention system utilized to alter movement. Descriptive accounts, while less than ideal and certainly not objective, can be improved by using the same format each time the movement patterns are observed. Devices which enhance accuracy of observation can also be used with descriptive recording to enhance inter-rater reliability and to improve test-retest reliability.

Measurement of Movement Through Electronic Devices

Machinery or devices associated with biofeedback and augmented sensory feedback training can be utilized to measure both frequency and duration of responses in relation to either motor outcome skills (milestone skills) or to movement processes (Harris, 1974; Wooldridge, 1975; Herman, Note 2). Many of these devices are marketed commercially can be fabricated for use by the teacher or therapist using readily available plans (e.g., Campbell, Middleton, Bricker, Simmons, and McInerney, 1982; Shein, 1980; Shein, Eng, & Mandel, 1982). All basic devices operate from electrical switch closures so that frequency and duration are measured on the basis of number and length of switch closures (Campbell and Bricker, 1981). These devices, when combined with automatic counters/timers, can be a valuable aid to measure behavior with automated means. Therefore, devices are best used for outcome skills and at present are insufficient for measuring postural tone and movement. The number of times a child moves an extremity or the rate of that movement in a fixed-time sample period can easily be measured using automated devices. The quality or pattern of that movement, however, is more difficult to control when measurements are made only by equipment. In essence, most devices will count anything that produces a switch closure whether that movement was performed with normal/atypical tone, normal/atypical postural fixations or normal/atypical patterns of movement. Many devices offer automatic and contingent reinforcement of movement [illegible] turning on toys, activating vibrator pads, playing music or other consequences that are easily delivered by automation. Therefore, use of devices with children with significant movement disorders can be extremely detrimental as the child may actually be taught to move atypically or taught to have increased tone (hypertonicity).

Measurement of Movement Through Standard Therapeutic Procedures

Active and passive ranges of motion at each joint of the body have traditionally been measured using a goniometer, a device, much like a protractor, to measure degrees of the angles made up by various body joints (Hoppenfeld, 1976). Active range of motion is a term used to describe the degrees of motion present at a given joint when movement is actively performed by the child. Passive range describes the possible degrees of movement obtained when the joint is moved by another person and not actively moved by the child. Both of these terms relate to static concepts regarding body alignment and posture and do not reflect skill acquisition. Therefore, measurements of active and/or passive range of motion are particularly critical with a child who has evidence of muscle tightness, elongations or contractures. Normal movement is not possible if joint ranges are constricted either because of changes in the muscles or in the joints themselves. However, increasing joint ranges (where limitations exist) or maintaining joint ranges at full range are important therapy targets with motorically impaired students.

Joint range measurements can be taken independent from learning programs or in conjunction with programs designed to teach more normal postural fixations and/or active movements. Figure 5 illustrates use of joint range measurements in combination with programming to increase length (duration) and quality (joint measurement) of movement in the kneeling position. This child had a tendency to kneel using atypical postural fixation at the hips that involved anterior tilting of the pelvis in combination with hip flexion. Hip flexors bilaterally were tight although full range was passively possible. Kneeling with full hip range in extension (180 degrees of extension at the hip joints) was reinforced in this program; responses with less than 140 degrees of extension were not reinforced. The kneeling program served not only to teach the skill of kneeling in an upright position, but also to increase joint range of motion in active movement.

Many children who have used compensatory patterns of movement for long periods of time have learned to move not only in atypical patterns but through using muscles in unusual ways. Movements performed using typically the same muscles may result in disuse or weakness of muscles not frequently used for particular movements. For instance, many children with disorders in postural tone do not acquire co-contraction of the shoulder and scapular muscles to provide fixation for upper extremity movement. The scapula may become fixed in a pattern of external rotation/abduction. If maintained for long period of time, secondary limitations in range of motion may develop particularly in the muscle groups that attach the scapula to the humerus. In addition, because the scapula adductors are not used, secondary weakness may develop in these muscles.

Traditionally, therapists are trained to perform ratings of muscle strength and weaknesses using a rating system that assigns designations from "0" (no strength) to "good". "Good" strength occurs when movement of a particular muscle or muscle group can be demonstrated against resistance and gravity. These rating procedures are difficult to implement with children since the ability to respond voluntarily to verbal direction is required. However, modifications can be attempted based on ability to exhibit functional movement patterns. For instance, if a child were able to flex the head (chin) against the trunk when lying supine, muscle strength of the neck flexors would be rated as good. If the child could perform the movement against pressure of a hand pushing the head downward, strength would be rated as excellent. Therapists can modify these procedures for use with young children and can measure the effectiveness when ratings are based on discriminations of components of movement. The most effective and accurate measurements are based on computerized analysis of all

factors related to movement. Nevertheless, because equipment is not readily available to therapists and teachers, measurement of movement can still be taken for assessment purposes, to document child change, and to determine the most appropriate intervention to be used to enhance movement abilities of handicapped children of all ages using the various methods outlined throughout this chapter.

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DEVELOPING LANGUAGE THROUGH COMMUNICATIVE INTERACTION

Linda L. Lynch & Johanna L. Lewis

Communication, in its various forms, takes place in a social context and may be defined as an interaction between or among two or more people. Communication may be verbal, involving the use of words; vocal, involving the use of sounds such as cooing, laughing and babbling; or nonverbal, involving the use of such things as facial expressions, movements and gestures. In many instances, nonverbal communication is as important as vocal and verbal in deriving meaning from a communicative interaction, and nonverbal signals often enrich or expand the meaning of the communication.

Language too, the symbol system with which we communicate, may be viewed from a social, contextual orientation. Language is both receptive and expressive. Receptive language--the input system--is what is received and understood from a communicative exchange; expressive language--the output system--is what is communicated (content) and how it is communicated (the form). Language is not limited to the common verbal system. In addition to the verbal system, manual language systems such as American Sign Language and Manual English and graphic symbol systems such as writing and Blissymbolics are in use. Whatever system is used, the objective of communication through language is to minimize the discrepancy between what is expressed and what is received between or among two or more people.

The set of rules which governs the use of language within a social context is known as pragmatics (Bates, 1976a & b). Pragmatics is concerned both with the intent behind the communication (e.g. to label, answer, request, protest and so on) and the function of the communication (e.g. regulatory, informational and so on). The correlation between the intent and function of a communication may be used to describe communicative ability. The development of intent and function in the communicative behaviors of children has been identified and described sequentially by Dore (1974, and Halliday, 1975). Within the social context, communicative ability may be assessed by observing how well intent matches function in an interaction and how well an individual draws upon content and form (e.g. verbal, vocal and nonverbal signals as well as the specific language structure and vocabulary) to correlate intent and function.

Description of Skill

The ability to communicate is an essential part of child development, and the communicative interaction that occurs between the infant and the adults in the beginning years is a necessary prerequisite to the development of the child's language skills and communicative abilities (Mahoney and Seely, 1976). Continued communicative interaction will allow the child to receive new information and ideas, increase understanding and practice new language skills within the social interactive context to achieve a variety of intents and functions. In other words, a child's language system, as well as his or her ability to use this system effectively to communicate, develops through the child's interaction with the people in the environment (Rieke, Lynch, and Soltman, 1977). It is through this interaction that the breadth and richness of the communication experience is achieved.

The development of appropriate communicative skills may be especially difficult for children who have special problems. This difficulty, in turn, affects the development of appropriate language skills. Therefore, educators of young handicapped children should pay particular attention to what is or is not occurring in the communication environment. Further, the information gathered about what is or is not happening should be used to help those children develop effective communication skills. In so doing, the early childhood educator will be able to assist those children in the development of the language and communication skills necessary to facilitate continued growth in both areas.

In order to assist handicapped children in language and communication skill development, the classroom teacher must have not only a working knowledge of child development, classroom management and preschool curriculum, but additional specialized skills for promoting communication. These skills include the following.

1) Planning and managing a preschool program that promotes the development of communicative interaction:
   - choosing activities to facilitate appropriate communicative exchanges
   - using management techniques appropriate to assist in the development of effective communicative skills.
2) Carrying out individualized communication programs for children within the regular classroom structure:
   - observing children and identifying their communication problems
   - planning a workable classroom intervention procedure
   - carrying out the intervention
   - evaluating the results and redesigning programs as appropriate.

If not already included in the curriculum, an additional emphasis in the preschool program for handicapped children should be successful communication with adults and peers in the preschool environment (O'Conor, 1975). Ideally, the classroom teacher should have a speech-language pathologist to assist in the development of a communication program. However, the services of the speech-language pathologist may not be available, making it even more essential for the classroom teacher to develop the necessary additional skills for promoting successful communication in the classroom. After all, it is within the daily classroom environment that the children are called upon regularly to demonstrate their effectivenes as communicators.

Assessment

To provide a frame of reference for classroom teachers and other resource people who are interested in implementing procedures for identification and management of communication and language problems, it is necessary to present the concept of the sequential nature of communication development (Rieke et al., 1974).

The two major communication behaviors which can be observed are initiating behaviors and responding behaviors. Initiating behaviors are those which occur spontaneously without anything observable having been said or done to get the child to say or do something. Responding behaviors are those which follow a preceding event, statement or question. For example, when you name a picture, the child points to it; when you give a command, the child responds by doing; and when you ask a question, the child responds by answering. Both initiating and responding behaviors may be used by the child for a variety of intentions (e.g. to seek attention, protest, tell about something or ask for information).

Both initiating and responding behaviors will normally appear before a child talks. Nonverbal initiating and responding behaviors include looking, reaching, touching, pointing,

giving and showing. The infant from zero to nine months initially uses certain unintentional nonverbal and/or vocal behaviors such as grabbing and crying that only "become" meaningful, functional and communicative as the adult in the environment interprets and responds to these behaviors.

As early as nine months the child begins using nonverbal, vocal and eventually verbal signals to communicate specific functions, intentions and meanings. As the child matures, the nonverbal/vocal behaviors progress to verbal sounds--single words, phrases and sentences.

Pragmatically the child's communication skills also increase and expand (Prutting, 1979). By the time a child is three or four years of age he or she uses sentences to ask, to tell about and to describe (initiates). He or she also answers fairly complex questions and follows fairly complex directions (responds).

As the child uses both initiating and responding behaviors to communicate and interact with others in the environment, he or she begins to engage in reciprocal interactions or turn taking. Those turn-taking behaviors later develop into skills necessary to become a conversational partner. Thus the child needs to develop not only the skills to initiate and respond, but also the ability to alternate those behaviors in dialogue with others.

In order to determine what data to collect from these observable behaviors, it is necessary to look carefully at the child's communication performance in the natural or typical environment such as the home or preschool. First it is necessary to determine if the child is communicating and how; second, to find out what some of his or her communication needs are in that setting; and third, to ascertain what is being said to the child and what materials are being used, so that lessons can be planned. Following are some general suggestions about what should be assessed or observed.

1. Is communicative interaction expected from the child?
   a. When?
   b. In what situations?
2. Does the child initiate communication?
   a. In what situations?
   b. With a variety of functions/intents?
   c. What happens to help him or her succeed?
3. Is the child responsive?
   a. Consistently?
   b. Appropriately?
   c. In what situations?
   d. What happens to help him or her succeed?
4. Is the child turn taking or combining initiating and responding behaviors?
   a. How many times per exchange?
5. What are the child's communicative successes?
6. What is the child's greatest need in this setting?

Measurement

Communicative interaction implies alternating behavior, turn taking or give-and-take even at the earliest levels of development. It can begin with the adult, who elicits a response from the child, which, in turn, requires an answer from the adult. For example, if a mother asks, "Where is your ball," the youngster may respond by pointing to the ball on the floor. The communicative interaction has not been completed until the mother comments, "Oh, it rolled into the corner." The communicative interaction can also begin with the child, who elicits a response from the adult, which then requires an answer from the child. The baby in the high chair reaches and strains. Dad responds, "You want to get down," and lifts her out. The baby

squeals and laughs. The important thing to remember is that communicative interaction occurs in units of at least three behaviors. To plot measurements corresponding to these behaviors, Kunze (1967) presented a three-column format for recording communicative interactions. Table 1 depicts in Kunze's format the foregoing examples of alternating behaviors.

Table 1
Communicative Units

	1.	2.	3.
Example 1	"Where is your ball?"	Child points to the ball.	"Oh, it rolled into the corner."
Example 2	The baby reaches and strains.	"You want down," and lifts him out.	The baby squeals and laughs.

The examples in Table 1 illustrate that communication can and does occur without words (e.g. child points; baby reaches). These nonverbal communications are important to recognize as they are some of the early building blocks of verbal communication. For the prelinguistic or nonvocal/nonverbal child, these nonverbal communications are the child's only or primary mode of communication. Furthermore, the nonverbal communicative behaviors may provide additional meaning to the communication, even if primarily verbal. In addition to inclusion of nonverbal communication in recordings of communicative interactions, it is imperative to record all "no responses" when something is expected in one of the columns but does not occur. Thus, the interaction may consist of alternating verbal behaviors as well as an alternating of any variety or combination of verbal and nonverbal behaviors. At a minimum, the person who begins or initiates the exchange should communicate again to facilitate the turn-taking behaviors.

The three-column format is useful for initially recording a child's communicative behaviors in the classroom. The following procedures will be helpful to persons wishing to use this system to obtain data in the classroom.

1. Prepare the three-column data collection sheet.
2. Determine when to collect the data (e.g., during peer interaction, snack, story, work time) and the time period (e.g., ten minutes a day for three days).
3. Record exactly what you see and hear. Try to avoid subjective terms or general descriptions. For example, say, "Dave turned away," not "Dave refused." Record "Dave 'da mai '__'," not "Dave unintelligible." "Dave continues playing," not "Ignored teacher."
4. Look at the child. Note if someone is interacting with him or her. Continue to observe as long as you can remember the exact behaviors. (Approximately 10-15 seconds, initially.) Look at the data form and write exactly what you saw and heard. While writing, try to ignore what is occurring in the classroom. When you finish writing, look at the child again and repeat the procedure. Try to aim for the observation of the communicative units, or the alternating of behaviors, minimally three as displayed in Table 1.

Table 2 depicts some examples of communicative units which are longer than three segments as was described in Table 1. In order to simplify later analysis of the data, record the child's behaviors in column 2. In example 1, Table 2, the child's behavior is a response to the teacher's behavior in column 1. In the second example, no behaviors are recorded in column 1, indicating that the child behavior is initiating behavior. Adding arrows to indicate the flow of the communicative units from column to column helps with analysis of the data later.

Table 2
Communicative Units

	1. Adult	2. Child	3. Adult
Example 1	Teacher points to picture, "What's he doing?"	"Doing," looks at picture	T. "Tell me 'He's playing.'"
		S. "He play."	T. "Good for you." Smiles, pats S.
Example 2		Susie tugs T.'s arm, holds up ball. "Ball."	T. "You have a big ball; show Jeff."
		S. walks to sand table.	

The behaviors recorded must be sorted or analyzed in order to determine problem areas and intervention procedures. Basically, the communicative units must be counted and categorized. First, information relating to the following questions should be sorted.

1. Is the child initiating communication? When?
2. Is the child responsive in the environment? When? Does the child do what he or she is told to do? Does he or she answer with words?
3. Is the child turn taking? When? How many turns?

Next, the information should be sorted to determine whether or not communicative interaction is expected of the child. For example, is the child allowed to "do his own thing" without contacting another child or adult or without being contacted by them? If communicative interaction is expected of the child, the data should also indicate when (e.g. during story time only) and in what situations (e.g., teacher asking questions about the story). Further sorting of the information recorded on the three-column data sheet will indicate what the child's communicative successes are (e.g., that he or she can answer more complex questions such as "What is that?" by naming objects, but cannot answer questions such as "What do you wear on your feet?" (Hedrick, Prather, & Tobin, 1975)).

Comparison of the child's abilities in both initiating and responding situations to a sequence of what is normally expected of children as their language develops will allow the observer to

determine an appropriate level of expectation for the child's communication attempts. Rieke, Lynch, and Soltman (1977), present such a sequence in Teaching Strategies for Language Development. For example, if a youngster was observed to initiate fifteen times with single words, seven times with two words together, but never with three or more words together, it becomes apparent that that child is not ready to use consistently three words together because he or she hasn't yet learned to use consistently two words together. Realistically, it would be more appropriate to facilitate consistent use of two-word constructions before trying to teach use of three word constructions.

Program Decisions Based on Data

When the child's communicative behaviors have been systematically recorded and analyzed or sorted into the various categories, it is possible to state what the child (1) can do (e.g., use single words), (2) can sometimes do (e.g., use two words together) and (3) cannot do (e.g., use three words together). In addition, it is possible to ascertain levels of language functioning by comparing the child's observed performance to a developmental sequence of language behaviors. By ascertaining levels of functioning, it is possible to identify those behaviors which are developmentally appropriate to expect, and therefore, behaviors to be encouraged or facilitated.

At this stage the specific program goal will be selected, and strategies to teach or facilitate accomplishment of the goal will be implemented. Strategies or program decisions can be easily displayed or organized in the three-column format (Table 3). This display or plan sheet makes it easy to see where program adjustments are needed and further to identify which adjustments have (or have not) helped the child.

Three considerations are important when planning a teaching program.

1. What the child can do, can sometimes do and cannot do.
2. What factors influence the child's success (e.g., materials, activities, what people say) and therefore what the teacher can present, do or say to elicit the desired response.
3. What influences the child's ability to succeed more often and more easily and to move ahead developmentally.

Table 3 displays these considerations in the three-column format.

Table 3
Plan Sheet

1. Adult	2. Child	3. Adult
2. what you present, do, or say to help	1. what the child can do--sometimes. the behavior expected of the child	3. what is done to influence the child's ability to succeed more often and more easily, and to move ahead

Reading from left to right on the plan sheet displayed in Table 3, the teacher will have a beginning script for the teaching interaction (Rieke, Lynch and Soltman, 1977). Choosing a behavior which the child can sometimes do as a program goal is based on the rationale that if the child can have some success at the beginning of the program he or she will enjoy working, will learn more easily, and will have some opportunities for receiving positive feedback from the adult in a spontaneous and natural way.

What the adult does to elicit the behavior listed as the program goal is displayed in column 1 in Table 3. The materials chosen for the teaching interaction should be something which the child likes and which comes from the child's environment. What is said and the manner in which those materials are presented to elicit the child's behavior should be carefully thought out and should be as communicatively natural as possible. Refer back to the original communication data for ideas of what does and does not work. The presentation should lead to success for the child. The more natural the interaction during the teaching situation, the more likely it is that the behavior will generalize or carry over to the daily or ongoing communication environment.

The third column in Table 3 denotes what the teacher will do and say when the child performs correctly as well as what the teacher will do and say in response to each kind of error the child might make. If the child is correct, some kind of reinforcement (e.g., social, the first and most natural choice whenever possible) is necessary to increase the likelihood of the correct response occurring again at the next level. If the child makes a mistake or does not do what is expected, the teacher must be prepared to respond in a way that will help the child do better next time. For example, if the child responds, but does so incorrectly, the teacher may simply give the correct answer and go on. If the child responds, but the response is unintelligible or the intent of the response cannot be judged, the teacher may want to model the correct response for the child to imitate. If the child does not attend long enough or well enough to respond, the teacher may want to cue the child physically or by using his or her name to increase the attention. If the child does not respond at all, the teacher may want to demonstrate the behavior and help the child perform, if appropriate. The information in the third column assures continual attention to encouraging the child's success; this column provides information for the child and models for the next step in his or her development, thereby reducing the need for "teaching prompts."

As the teaching plan is implemented, use of the three-column plan sheet to record the child's behavior during the teaching session will facilitate making necessary changes in the program. For example, it is possible simply to tally when the child is correct, when he or she makes a specific error and when he or she doesn't respond at all. In so doing, patterns will become evident which will allow the teacher to determine the child's consistency and eventual accomplishment of the goals, or to determine the kinds of errors which persist and what changes the teacher can make to help the child eliminate the errors and respond correctly.

Table 4 displays a plan sheet which includes the tally marks recorded during the teaching session. (The goal described in Table 4 for Kara was chosen to facilitate Kara's responsive behavior in the classroom. The lesson itself was conducted in a 1:1 situation within the classroom setting and was implemented when analysis of Kara's language and communication abilities revealed a low level of receptive vocabulary.) Examination of Kara's response pattern in Table 4 indicates that she is responding correctly fifty percent of the time (five out of ten trials). There were two errors which the teacher corrected by simply prompting with a gesture, and there were three errors due to inattention, which the teacher recorded as errors in the tally, but which the teacher also managed into a new turn. Recording Kara's behavior in this fashion allowed the teacher to determine specific procedures for dealing with errors and when to move on to new tasks. Kara learned this one.

Summary

Because the young handicapped child may have difficulties developing appropriate communicative interaction and thus appropriate language skills, the early childhood teacher has a responsibility to pay particular attention to what is or is not occurring in the communication environment. In order to do that, it is necessary for the teacher to be familiar with the sequential nature of communication and language development. The primary communication behaviors with which to be concerned are initiating behaviors and responding behaviors. Both kinds of behaviors develop sequentially from nonverbal to vocal to verbal--single words, words together and sentences.

Table 4
Plan Sheet with Tally Marks

Plan Sheet

NAME: Kara GOAL: To respond to simple directions

Adult	Child	Adult	Tally
2. Materials: toys (doggie, baby, boat Procedure: place one toy at a time	1. To give named toy	3. Correct = Feedback: "That's right, you gave me the __." Error = Incorrect - Demonstrate expected behavior by gesturing for her to give; then praise giving. Error = Not understood - Help her give the toy and praise giving. Error = Inattention - Withhold attention and toy; wait for her to attend; then repeat direction as a new turn. Error = No response - Point to the toy and gesture for her to give it, then praise giving.	IIII II III

By recording a child's communicative interactions in a three-column format, paying particular attention to communicative units, the teacher has pertinent information which can then be analyzed as the basis for designing intervention procedures. Selection of a teaching goal and the specific procedures for attaining that goal necessitates careful examination of what the child can do, can sometimes do, and cannot do. Further, careful attention to the child's abilities as they compare to a normal developmental sequence of language and communication behaviors allows for determination not only of reasonable expectations for that child's present performance in the classroom, but also of reasonable expectations for what might be expected of his or her performance as his or her skills develop.

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MEASURING SELF-HELP SKILLS*

William G. Moore

One of the overriding philosophies of educational programs developed for moderately and severely handicapped individuals is to provide the individual with as many skills as necessary for them to function as independent members of society. One of the most critical areas in which individuals must exhibit independence is in the care and maintenance of their own needs. Abilities acquired in this area to insure independence are usually identified as self-help skills. Typical sets of skills within this area are self-feeding, dressing, undressing, personal hygiene and self-grooming. Another set of skills that would usually come in this domain is toilet training. For the purpose of this chapter toilet training will be considered an independent area from self-help and will not be covered. For more information on toileting, the reader is referred to Toilet Training the Handicapped Child (Fredericks, Baldwin, Grove, & Moore, 1981).

Description of Self-Help

If a young moderate to severely handicapped child is to develop and function independently in a community, self-help skills as identified in this chapter will be paramount to insure that success. Self help skills appropriate for teaching in a classroom for the severely handicapped are self-feeding, dressing, undressing, and personal hygiene, to include washing, brushing teeth, combing hair, and bathing. In the classroom, the teacher must first determine the repertoire of skills which the child has, then either enhance those skills or teach the child additional skills. The problem, however, is more confounding to the teacher who is faced with a child who possesses no self-help abilities at all. In that case, the teacher must begin teaching those skills which normal children usually develop first. For instance, an initial concern should be to teach the child to feed him or herself, first by hand then with utensils.

Dressing and undressing should begin as soon as the child exhibits an interest in trying to remove articles of clothing. For the more severely motor-impaired child, a system of teaching to undress and dress should be initiated by age three, utilizing whatever range of motion he or she may possess. Washing hands and brushing teeth should also begin by age three, again taking into consideration the motor abilities of the child. Combing hair and bathing follow the skills of washing and brushing of teeth.

Thus, by the time the child is three to four years of age, if he or she has not yet gained some self-help skills, programs should be begun in the areas of self-feeding, dressing and undressing, and personal hygiene. The general philosophy is to start the child in these programs as close as possible to the age at which "normal" children begin to exhibit these skills.

*Concepts presented in this section are taken from two publications: (1) A Data Based Classroom for the Moderately and Severely Handicapped (Fredericks et al., 1982), and (2) The Teaching Research Curriculum for Moderately and Severely Handicapped: Self-Help and Cognitive (Fredericks et al., 1980). The reader is referred to these two sources if further information is desired.

Self-help skills can be taught exclusively in the classroom, but they are most efficiently taught when instruction occurs concurrently at home. Because these skills can only be maintained in the home, the parents are the prime teachers of these skills. The teacher is encouraged to involve the parents in this training and to conduct programs for the parents as described in Isn't It Time He Outgrew This? (Baldwin, Fredericks, and Brodsky, 1973).

The approach to teaching self-help skills is the same as with teaching other tasks. The particular behavior to be taught (putting on pants, brushing teeth, self-feeding with a spoon) is task analyzed into its component parts or steps and the task is sequenced. Using this sequence as a base, a program is written for the child, starting at his or her present level of competency and teaching each step of the remainder of the program until he or she is able to perform the terminal behavior. Appropriate reinforcers are selected for each child. In the remainder of this section, each of the self-help skill areas is discussed separately, focusing on unique features of the curriculum and techniques for teaching.

Self-Feeding

Self-feeding is probably the self-help skill which should be attempted first with a child. A child usually has a natural tendency to put things into his or her mouth, so teaching self-feeding capitalizes on this natural tendency. The ultimate objective, of course, is to have the child feed him or herself using a knife, fork and spoon, and to enable him or her to handle these utensils as an adult or a "normal" child does.

Before a child is able to use even one of these utensils, he or she will usually pick up food and eat with his or her fingers. Therefore finger feeding should be encouraged in order to teach the child the amount of food he or she should put into the mouth at one time and to help develop proper chewing habits. Occasionally, a child may have to be taught to finger feed, picking up one item of food at a time. He or she should be taught not to pick up another piece until he or she has eaten the previous one. This can be accomplished by placing the food on the child's tray one piece at a time and then gradually increasing the number of pieces. Only food that is an appropriate finger food should be used. Baby vienna sausage, cereal bits, sandwich meat, fruit and crackers are very suitable.

Once a child is adequately feeding him or herself using the fingers, he or she is ready to learn how to use a spoon. The best approach is to use the reverse chaining process. In this process, the teacher places his or her hand over the child's hand as the child grasps the spoon. The teacher and child then scoop the food and bring it to the child's mouth. After the teacher has guided the child's hand to the mouth and back to the bowl a number of times, the teacher guides the child's hand almost to the mouth and releases so that the child will take the food the rest of the way into the mouth. The teacher gradually releases the child's hand farther and farther from the mouth, until the child eventually learns even to scoop the food by him or herself. Once a child learns to use a spoon, he or she should progress to a fork, and finally to a knife.

The opportunity to teach a child self-feeding in school presumes two things: first, that the child is in a school situation at appropriate times to be fed, and second, that the child enjoys those foods selected for use in training. Thus, it is strongly recommended that all schools for severely handicapped children be scheduled through lunch period in order to allow the teacher the opportunity to teach feeding. In addition, the instruction may have to be done with desserts or with other special foods which appeal to the child.

Reinforcement with feeding is built into the system. The primary reinforcer is the food which the child is eating. Social reinforcers should be administered frequently by the teacher during the feeding instruction.

Eating utensils, bibs and cups are extremely important in teaching the child to feed him or herself. A bib which contains a plastic, nonflexible catchall is strongly recommended in that it is very effective in catching spilled food. Eating utensils chosen for the handicapped child should be no different than those for a normal child. Child-sized utensils are especially recommended. However, if the child has physical disabilities in the upper extremities which may interfere with his or her ability to move the spoon from the bowl to the mouth, it may be necessary to have specially constructed eating utensils to compensate for the disability. A number of commercial firms make these types of utensils, and a catalog is available from the Fred Sammons Company (Box 32, Brookfield, Illinois, 60513). In choosing a utensil, the teacher should coordinate with the parent.

Even if special utensils are not required, it is often necessary to enlarge the handle of a utensil to allow the child to hold it more easily. Any artifical enlargement should be considered a temporary measure. As soon as possible the child should be encouraged to use the utensil without this additional aid. Enlarging the handle can be done in a variety of ways. One simple technique is to cut the handle from a bleach bottle and insert the utensil into the handle. Another way is to tape rubber tubing to the utensil. Taping the handle of the utensil enlarges the spoon and provides an easy way to reduce gradually the size of the handle, for the tape can be removed in stages until the spoon is back to its normal size.

The choice of a cup from which a child is to learn how to drink is quite important. It is helpful if the cup contains a plastic cover. Many such cups, which are commercially available, have nozzles similar to a nipple which would be ideal for the child who still drinks from a bottle. As soon as possible, the child should be weaned from this nipple cap and given another type of plastic cap to place over the glass. This cap has a small hole which can gradually be widened by cutting out the top and allowing more fluid to flow through. As soon as the child has practiced with this so that he or she does not spill, the hole can be made wider until eventually the cap can be removed from the cup altogether.

Dressing and Undressing

Dressing and undressing skills have a relatively low priority in the instructional scheme, for both teacher and parents. Parents usually are reluctant to spend the time and frequently do not have the patience to teach each of the dressing skills required for the severely handicapped child. Teachers usually do not face the problem of teaching these skills except for such times as taking off and putting on coats which, if the child could do, would save time in the classroom. However, it is necessary for both the teacher and parent to approach the problem of undressing, dressing and fastening systematically.

The question that first comes to mind is where to begin, and the answer is certainly to begin with undressing skills. The average child will, relatively early in his or her development, begin to make efforts to undress, usually at very inconvenient times. You will see children playing outside who sit down to take off shoes and socks or underpants. These are efforts at exploring and demonstrating their capabilities of performing undressing skills. Thus, when a child is making these explorations, he or she should be encouraged to learn how to undress, dress and fasten. With some severely handicapped children, however, these explorations may not occur. Nevertheless, if the child is two years old, efforts should be begun to teach him or her to undress, dress and fasten.

Although undressing is to be taught first, a child need not master undressing before starting to learn the dressing or the fastening skills. Table 1 shows the order in which most children learn the various articles of clothing or equipment that they must master in undressing, dressing and fastening. For instance, socks are the easiest thing for children to take off; shoes are probably the next easiest, followed by pants and underpants. Pull-over shirts are the most difficult, since the child often has trouble pulling a shirt over his or her head or disentangling his or her arms. In fastening, zipping and unzipping are the easiest skills. Unsnapping is the next easiest, since it requires only a pulling motion, while snapping is the most difficult of all the dressing skills.

In teaching dressing skills, it often helps in the beginning to use oversize materials and clothes, thereby exaggerating the cues given to the child. These oversize clothes allow the child to manipulate easily the material and to succeed at completing the task. As he or she increases proficiency with these oversized materials, the size can gradually be reduced until he or she can accomplish the same task with normal size clothing. The use of oversized clothing is especially important in such tasks as buttoning and unbuttoning, where fine-motor coordination skills are required.

Form boards for buttoning, zipping and snapping should be used only as preparation for learning these skills. Because of the difficulty of transfer of learning from an item placed on a table before the child to an article of clothing the child wears, there is little advantage in using form boards. Teaching the skill with oversized garments has been found to be more efficient than using form boards.

Hygiene Habits and Self-Grooming

As with feeding and dressing, it is necessary to pinpoint the various tasks included in hygiene habits -- washing hands, combing hair, brushing teeth, taking a bath -- which the child can do, sequencing the steps in the task, and teaching each individual step if necessary. These tasks should also be reverse chained.

There is, however, another consideration here. When one tells a child to wash his or her hands, one expects that he or she will go to the bathroom, turn on the water, get the soap and wash the entire area of both hands. The severely handicapped child, however, may initially be able to approximate these behaviors, but may miss washing part of one hand or drying parts of another hand; he or she may fail to return the soap to its proper place, may not completely shut off the water or may not perform a myriad of other tasks normally required for completion of the task. When one considers the complexity of these tasks (there are eleven steps in just learning to wash hands, without even considering the task of drying them), one should initially be willing to accept less than perfect accomplishments. As the child's performance is observed, the teacher must pinpoint those areas that the child has performed incompletely and work on those as individual tasks to be improved or learned.

Assessment and Measurement

Testing Cumulative and Noncumulative Skills Programs

There are two types of sequences generally included in any curriculum: cumulative and noncumulative. An understanding of each is necessary in order to successfully conduct a placement test which pinpoints as accurately and effectively as possible the child's acquired skills and deficiencies in each area of the self-help curriculum.

Table 1
The Most Common Sequences of Learning
for Undressing, Dressing and Fastening

Undressing

1. Socks
2. Shoes
3. Pants and underpants
4. Shirts or coats, button type with buttons open
5. Shirts, pull-over

Dressing

1. Underpants
2. Pants
3. Socks
4. Pull-over shirts
5. Shirts, button type
6. Shoes

Fastenings

1. Zipping and unzipping
2. Unsnapping
3. Unbuttoning
4. Buttoning
5. Tying Bows
6. Snapping

Cumulative skills programs are those which teach one terminal behavior; the phases and steps of that program build up to one terminal goal. When placement testing a cumulative skill such as "Puts on Jacket," it is only necessary to test at the most difficult step of the task analysis. When teaching a skill such as this, it is necessary to acquire Step 1 of the skill before one can go on to Step 2. With each new step of the program, the child is required to perform a greater portion of the task independently. Therefore, if the child can perform Step 9 (the most difficult step) independently, it is asssumed he or she can perform the simpler Steps 1 through 8. If a child cannot complete Step 9 independently and needs a great deal of assistance, the teacher records "no" on the placement test form next to the skill "Puts on Jacket." It would not be necessary during placement testing to test the other eight steps in the program since the placement test is a gross assessment of the child's skills. More specific testing of steps in the program will occur during baselining procedures which pinpoint the exact phase and step at which to begin teaching a skill. It should be noted that all self-help programs fall within in the cumulative skills area.

Noncumulative skills programs are those which teach more than one discrete terminal behavior. These programs have a finite number of different behaviors listed such as "Writes twenty-six lowercase letters" and "Finds Colors." When placement-testing programs of this type, it is both too time-consuming and repetitious of the baseline to test all the behaviors included in the program. For these programs, a small sample of behaviors has been chosen and included on the placement form to test. These behaviors were identified based on providing (1) a representation of varied age normal with a skill, (2) behaviors to test that are common to most students' environments and (3) test items that require common or simple materials.

Table 2 contains part of the Teaching Research placement test for the self-help area (Fredericks et al., 1980). The child must complete the task specified in the terminal objective of the program within a maximum of three trials. Separate trial data (X = correct; 0 = incorrect) are recorded on the placement test form. In order to pass the test for each

Table 2
Teaching Research Placement Test for Self-Help Skills

EATING

	Program and Suggested Cue	Placement Test					Baseline		Posttest		Comments
		Trial		Data	Yes/No	Date	Data	Date	Data	Date	
	EATING										
A	Eats textured foods - "eat"										0-24 months
B	Chews - "chew"										8-12½ months
C	Feeds self using fingers - "eat" (model)										9-12 months
D	Transition from bottle to cup										9-15 months
E	Drinks from cup - "drink" (model)										12-18 months
F	Eats with spoon or fork - "use your spoon/fork" (model)										15-24 months
G	Drinks with straw - "use the straw to drink" (model)										2-3 years
H	Uses napkin - "use your napkin"										2½-3 years
I	Pours liquid into glass - "pour the (milk)"										2½-3 years
J	Clears place at table - "clean your eating area" (designates area by pointing)										3-4 years
K	Passes food - "pass me the (bread), please"										3-4 years
L	Spears food with fork - "poke it"										3-4 years
M	Spreads with knife - "spread the (butter)"										4-5 years
N	Cuts food with spoon or fork - "cut the (banana)"										4-5 years
O	Cuts with knife - "use your knife and cut the (hamburger)"										5-6 years
P	Serves self food - "help yourself"										4-5 years

objective, the child must give two correct responses out of the three trials. If the child succeeds on the first two trials, he or she moves to the next objective. If he or she fails the first two trials, then no further testing is made for the particular objective. Furthermore, if this is the third consecutive objective that the child has failed, then no further testing is done in this entire area. When the child succeeds on one trial and fails on the other, then a third trial is administered. If he or she succeeds on the third trial the child is given credit for passing that objective; if he or she fails the third trial, the child is not given credit for the objective.

After placing the child, the teacher occasionally finds that the placement has been erroneous. One should not hesitate to make adjustments in placement as better evidence of the child's capabilities becomes available. Programs not included in the curriculum that are written by the teacher to provide individualized programming specific to a particular child's needs may be written in one of the blank lines following each curricular area.

Preparing for the Placement Test

Before the placement test is conducted, two steps must be taken.

Allow time for adjustment. Allow adequate time for the child to adjust to his or her new environment. This is important since a child's skills may be inhibited or altered merely because he or she is in an unfamiliar setting. The amount of time needed for a child to adjust to the new environment varies with the individual, and it is up to the teacher to be sensitive to the child's ability to feel at ease. Some indications of adjustment are when the new child allows adults or peers to approach without withdrawing, when he or she approaches others to communicate a need or gain affection, when he or she actively participates in the structured group activities or when he or she engages in free play activities with peers.

To avoid a possible adverse situation for the new child, the testing session should not be unduly long. Several test sessions with frequent free-time breaks, possibly over several days, may be necessary depending on the attention span and skill level of the child.

Obtain information. Gather as much information about the child as possible through conferences with parents and former teachers and by observing closely the child's behaviors in the classroom. The conferences can provide information about the behaviors the child may exhibit in a familiar setting and about the items that are effective reinforcers (favorite toys, food, social praise, tokens, etc.). By informally observing the child's behaviors in the classroom, the teacher is able to determine a point more accurately at which to begin placement testing. For example, if during lunchtime the teacher observed that the child was able to feed him or herself quite well with a spoon and drink from a cup with minimal spillage but that he or she did not attempt to use a fork, knife or napkin, the teacher could deduce that a logical place to begin testing self-feeding skills would be with program G, "Drinks with a straw" (see Table 2). During the initial adjustment period, the teacher can also identify possible reinforcers by observing what toys, food, events and people the child enjoys the most. These will be needed to reward the child for good behavior and "working hard" during the placement test.

Where to Begin Testing

Information gathered about the child's skills from parents, from former teachers and through informal observations prior to placement testing will provide a point at which to begin testing in each curricular area. If, for example, a teacher observed at lunchtime

that a child was able to eat hard, crisp foods (final phase of "Eats Textured Foods"), drink from a cup and eat using a spoon, the teacher would begin testing at program G, "Drinks with a Straw" (Table 2). Skills that follow on the placement test are then tested until the child does not meet criteria on three skills. Also, any skills preceding the first skill tested about which the teacher has insufficient or no information should be tested.

A bracketing procedure is used for those curricular areas for which the teacher does not have sufficient information to identify a starting point for placement testing. Bracketing provides an efficient determination of program placement because it is a procedure that avoids the need to test every sequence in a particular curricular area.

The bracketing procedure begins with dividing the curricular area into sections of eight to ten skills, grouping the skills by developmental age norms. Thus, skills occurring between one and two years are in one section, two to three years in another, and so on. The teacher should then be able to determine the section in which to begin testing.

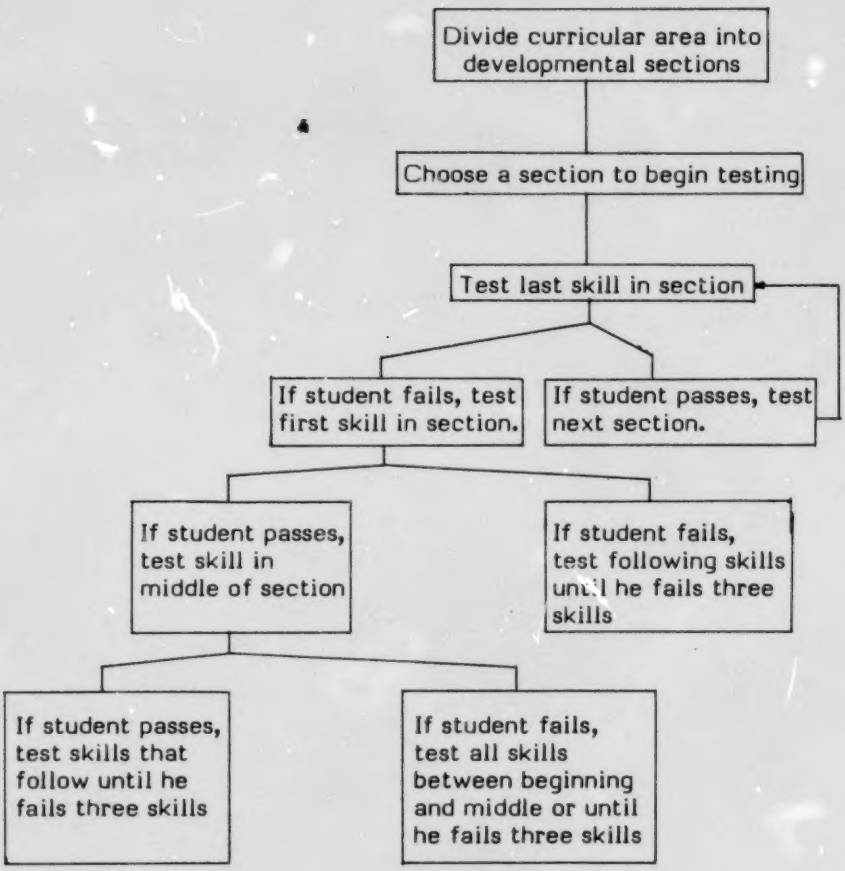
Bracketing is a process whereby skills are tested at the end, beginning and middle points of each section. Final determination of possible programs for placement depends on whether the child passes or fails at those points. Refer to Figure 1 for the flow chart for bracketing procedures. Testing begins with the last skill in the section. If the child passes, he or she goes on to the next section and attempts to perform the last skill in that section first. if the child fails the skill at the end of the section, the teacher then has him or her try the skill at the beginning of the section. If the child fails at that point, the teacher tests him or her on each of the skills that follow until the child fails three skills. If, however, the child meets criterion on the skill tested at the beginning of the section, the teacher should test a skill in the middle of the section. If the child fails this middle skill, then his or her level of performance probably lies somewhere between the beginning and the middle; the teacher then tests those skills from the beginning to the middle points of the section until the child fails to meet criterion on three skills. From the information received during the placement test, the teacher, parents and possibly the support personnel prioritize the skills that the child was unable to perform, and which, therefore, he or she must be taught.

Reinforcement Procedures

The procedures for reinforcement during a placement test, baseline test and posttest are the same. Primary, tangible and/or social reinforcers are delivered throughout the placement test, contingent upon appropriate behaviors, such as attending to a task, maintaining eye contact, waiting patiently or following commands not related to the task being tested ("come here, sit down, give me the toy"). Reinforcers are not delivered, contingent upon correct performance on the specific test items. The rationale for this procedure is that delivery of reinforcers contingent upon correct performance constitutes treatment or teaching. On the other hand, the placement test, baseline test (pretest) and posttest constitute evaluation of the child's performance prior to or after treatment. During these tests, however, reinforcers are delivered in order to maintain those behaviors (attention to task, sitting, waiting, etc.) necessary for a smooth and pleasant testing situation, and to keep the student motivated to continue attempting new tasks.

The frequency with which reinforcers are delivered is unique to each child. Profoundly handicapped children may require primary and social reinforcement at a high rate (every fifteen

Figure 1
Flow chart for bracketing procedure.


Divide curricular area into developmental sections
Choose a section to begin testing
Test last skill in section
If student fails, test first skill in section.
If student passes, test next section.
If student passes, test skill in middle of section
If student fails, test following skills until he fails three skills
If student passes, test skills that follow until he fails three skills
If student fails, test all skills between beginning and middle or until he fails three skills

seconds), while the moderately handicapped adolescent may work for the entire placement test session given only periodic social praise and a free time break after thirty minutes. Again, the teacher can determine the frequency of reinforcement through information gathered from parents, from former teachers and through his or her own informal observations prior to the placement test.

Baseline. When placement is complete, the teacher, in conjunction with the parent and possibly support personnel, arranges by priority skills that the child is lacking and chooses those skills to be taught. At this point a baseline is conducted to pinpoint specifically what phases and steps within each skill the child does or does not have. Thus, an accurate place to begin teaching a particular skill is determined. Because a child may have mastered portions of a skill before training begins, it is necessary to take a complete baseline. Baselining begins with the most difficult level of the program and then proceeds to easier levels until the criterion of two out of two correct responses is obtained at any phase or step. This will enable the teacher to skip teaching phases and steps the child already has and the date on the placement test form (see Table 2).

Posttest. After a skill is completed, a posttest is given to be sure the behavior has been maintained in its entirety. Only the terminal objective is tested. Criterion is two out of two correct responses. When testing is completed successfully, the date and total steps for the skill are recorded in the posttest column of the placement test and added to a maintenance file if necessary. If testing is not completed successfully, the missed steps are studied to determine where to begin teaching or to determine if the reinforcer needs to be faded more slowly.

Probe. The baseline and posttest are conducted before and after a treatment program, respectively; a probe is a test that is conducted primarily while the program is in progress. Pass criterion is two out of two correct responses, as for baseline and posttest procedures. Unlike the baseline test, posttest and placement test, reinforcement is delivered for the target behavior being tested. There are four ways in which a probe can be used.

1. Review probe. A frequent and regular schedule of probes can be used to review the acquired skills in a multiple or noncumulative skill program.
2. Probe ahead. Children occasionally progress through programs at a much faster pace than expected. This rapid progress usually occurs for one of two reasons: (1) the child was initially assessed erroneously in the program; (2) after the child has acquired the initial steps of a program, the remaining steps, which are extensions of the initial steps, are more easily acquired. A pattern of data indicating this phenomenon emerges when the child progresses through three to four steps with one or no errors; therefore, the decision of the teacher is to probe ahead. A probe of this nature presents a maximum of two trials, using the same reinforcers and schedule as during other programming.
3. Probe backward. When faced with data that reflect little or no success, there are certain considerations the teacher must make. There is the possibility that the poor performance of the child may be due to erroneous data at the previous step; therefore, the teacher should designate that the previous step be probed to ensure that the child is able to accomplish it. If the child can demonstrate in the probe that he or she can perform the previous step, the program probably needs to be branched (further breakdown of the task). If he or she cannot, the child will have to be placed in the program where he or she can accomplish the step.

Another reason that a child may be unable to perform the previous step of a program is that the criterion level for moving to the next step may be set too low for mastery to occur. The child may therefore "forget" the skill learned on the previous day. If this occurs more than once in a particular curricular area, the criterion for moving to the next step should be raised. For instance, if the criterion has been three consecutive responses before moving to the next step, it probably should be raised to five consecutive responses, possibly over two or more consecutive days.

4. Probe after posttest. If the child fails on the posttest, a probe of the missed phases or steps can be conducted. This serves two purposes: (1) if the child was unsuccessful because he or she "forgot" how to perform the task, the teacher is able to identify where to begin reteaching; (2) since tangible or primary reinforcers are not delivered for correct performance of the target behavior during the posttest, failure on the posttest might indicate a need for fading the reinforcers used during the treatment program. Success on a probe conducted after an unsuccessful posttest would verify the need for fading reinforcers (since reinforcers are delivered during the probe for correct performance).

Data--The Essence of Individual Programming

In order to provide efficient individual programming, the teacher must be able to measure accurately the skills and capabilities which a child possesess in all curricular areas. The teacher must further be able to track the child's progress through the curricular areas.

Implied in this tracking procedure is the necessity to respond to the data collected. For instance, if a teacher is instructing a child in a particular self-help program and the data which are being gathered about the child's progress indicate that no progress has been made for the past two days, the teacher should modify that child's program by implementing the following changes in the order prescribed: 1) increase the power of the reinforcer; 2) reduce the complexity of the task; and 3) modify the means of presenting the materials. On the other hand, if the child is moving through the steps of a sequence at a rapid rate with few incorrect responses, the teacher should probe ahead to determine whether the child possesses more advanced skills which would allow him or her to move through that sequence more rapidly or to skip portions of the instructional sequence.

In both instances the data are telling the teacher to alter the child's program. This ability to respond to the data and to modify programs accordingly is the essence of individual programming. Therefore, to function effectively in this system teachers must be able to make as accurate an initial assessment as possible on the capabilities of the child, to place the child in the scope and sequence of the curriculum and to maintain data on his or her progress so as to modify the program when needed. In addition, the teacher must be prepared to inaugurate programs to change and measure social behaviors which interfere with the learning process -- tantrums, crying, aggressive behavior, non-compliance and others.

Tracking Skill Acquisition Programs

After the initial assessment has been made in a curricular area, the teacher is ready to commence the child's instructional program. This of course assumes that there are no social behaviors which will interfere with the instructional program and prevent learning from occurring. If there are such behaviors, they should be treated first.

Let us review an example of a child who does not have such behaviors and who has been placed in a self-help skills program for feeding himself. This child is beginning to learn to eat with a spoon. The phases and steps that the child will go through are shown in Table 3.

Table 3
SELF-HELP
Phases and Steps of Eating With a Spoon

Phase V Eating with a spoon or fork: Child scoops food himself and returns spoon to dish.

Steps:

1. Move hand to mouth from dish, and back to dish.
2. Release hand 1 inch from mouth, return spoon to dish.
3. Release hand 3 inches from mouth, return spoon to dish.
4. Release hand 5 inches from mouth, return spoon to dish.
5. Release hand 7 inches from mouth, return spoon to dish.
6. Release hand 10 inches from mouth, return spoon to dish.
7. Release hand 13 inches from mouth (add any additional steps required), return spoon to dish.
8. Release hand immediately above plate, return spoon to dish.
9. Release hand as food is scooped, and return spoon to dish.
10. Child scoops food himself and returns spoon to dish.

The program is to be conducted daily and is described on a program cover sheet, Table 4.

When preparing to administer these programs for the child, it is convenient to place the program cover sheet (Table 4) preceded by the sequence of steps (Table 3) and followed by the data form (Table 5) on a clipboard. In the right margin of the data form there is a space for the date. The far left column shows the reinforcer which has been used. The next two columns of the data form show the phases and steps of the curriculum sequence to be taught. The following ten columns are for recording the results of each trial or each time the child tried to perform the behavior. The final column, "comments," provides space for the teacher to make notes about the child's performance. Only two types of marks are recorded in the trial boxes. An X indicates that the child has performed the step correctly; an O indicates that the child performed the step incorrectly or did not respond after receiving the initial cue. The same data recording form is used for all skills which the child is being taught.

Updating

The purpose of a continuous data system is to provide daily feedback so that the teacher can modify a child's program in a timely fashion in order to optimize the rate of learning of the child. Thus data are recorded after each trial and are examined daily, usually after instructional hours, to determine if a change in a program is necessary. This examination of data, making decisions about change and recording the program for the next day is called updating.

There are six possible major decisions which a teacher may make about a program during this updating process.

(1) Maintain the program as is.
(2) Probe ahead to determine if the child can perform at a more advanced step of the program.

Table 4
Program Cover Sheet

Pupil: "Tim" Date Started: 3/3 Date Completed:	Program: Eating with a spoon or fork
Verbal Cue: "Eat, Tim."	Materials: Dish with food; spoon or fork; place removed from rest of family
Non-Verbal Cue: Teacher stands or sits to the right rear of child. "Tim" is right handed, spoon is placed on table before beginning.	Reinforcement Procedure: 1:1
Correction: "No, eat, Tim." Physically assist and socially reinforce.	Criterion: Three consecutive correct responses.

Table 5
Data Form

Teaching Research Infant and Child Center Raw Data Sheet

Name:_____ Program:_____

X = Correct
O = Incorrect

Reinforcer	Phase	Step	Trials 1	2	3	4	5	6	7	8	9	10	Comments	Date

(3) Change the reinforcer being used with the program
(4) Branch the program to add additional steps in the program which either will make the task easier or will provide additional support to the child while performing the task.
(5) Probe backward to determine that the child has mastered previous steps.
(6) Temporarily cancel the program.

The data pattern plus knowledge about the child's previous performance dictates which of the above decisions the teacher will make during the updating process. A discussion of each follows.

Maintain the Program. If a child is progressing satisfactorily in a program, the teacher will continue that program during the next class day. A number of data patterns for a particular program will elicit this decision. Table 6 shows a pattern where the child had reached criterion (three consecutive correct responses) for a step in the program. The update for that program is merely designating the next step in the program. This is shown for 2/6 (February 6) in Table 7. Notice that the teacher has not specified the reinforcer to be used for the next day. This lack of specification means that the volunteer may select the reinforcer for the child.

Table 8 presents a different data pattern. It is obvious from this pattern that the child has had intermittent success throughout the day 2/5. Since he has been working on this step of the program for only one day, the decision of the teacher is to maintain the program for another day. The updating decision as recorded on the data sheet appears in Table 9. Again, there is no need at this time to specify the reinforcer.

Probe ahead. A child occasionally progresses through programs much faster than expected. This rapid progress usually occurs for one of two reasons: (1) the child was initially assessed erroneously in the program; (2) after the child has acquired the initial steps of a program, the remaining steps which are extensions of the initial steps, are more easily acquired. A pattern of data indicating this phenomenon appears in Table 10. The child has progressed through steps 3, 4 and 5 with only one error. Therefore, the teacher decides to probe ahead. A probe of this nature is to present two trials, using the same reinforcers and schedule as during other programming. This decision is reflected in the data sheet shown as Table 11. If on 2/7 the child succeeded in both trials at all three steps and the program had additional phases, the updating decision on 2/7 would be to provide the terminal step of the remaining phases of the program.

Change the Reinforcer. Table 12 shows data for a two day period during which the child has been exhibiting intermittent success. This pattern indicates that the behavior is within the capability of the child but that the child perhaps needs a greater incentive to emit the behavior consistently. Therefore, the pattern suggests that the teacher should designate a reinforcer known to be more powerful for the child. That decision is reflected in Table 13. In this case, raisins are to be used as reinforcers during the next day's teaching. Thus, the volunteer is not permitted to choose the reinforcer.

Branch the Program. Table 14 presents a situation where the child is not succeeding within a program, nor is the evidence sufficient to demonstrate that a behavior is in a child's repertoire of behaviors. This pattern probably indicates that the program should be branched by adding additional steps to the behavioral sequence. These additional steps are designated on the behavioral sequence sheet by subletters added to the phase or step. Branching can usually occur in one of three ways.

Table 6
Data Pattern for Maintaining Program

Teaching Research Infant and Child Center Raw Data Sheet

Name:_____ Program:_____

X = Correct
O = Incorrect

Reinforcer	Phase	Step	Trials 1	2	3	4	5	6	7	8	9	10	Comments	Date
Raisin/ Social	IV	3	O	X	O	X	X	X						2/5

Table 7
Update for Data Pattern in Figure 6

Teaching Research Infant and Child Center Raw Data Sheet

Name:_____ Program:_____

X = Correct
O = Incorrect

Reinforcer	Phase	Step	Trials 1	2	3	4	5	6	7	8	9	10	Comments	Date
Raisin/ Social	IV	3	O	X	O	X	X	X						2/5
	IV	4												2/6

Table 8
Data Pattern for Maintaining Program

Teaching Research Infant and Child Center Raw Data Sheet

Name:_____ Program:_____

X = Correct
O = Incorrect

Reinforcer	Phase	Step	Trials 1	2	3	4	5	6	7	8	9	10	Comments	Date
Raisin/ Social	IV	2	O	X	O	O	O	X	O	X	X	X		2/4
Raisin/ Social	IV	3	O	X	O	X	X	O	X	O	X	O		2/5

Table 9
Update for Data Pattern in Figure 8

Teaching Research Infant and Child Center Raw Data Sheet

Name:_____ Program:_____

X = Correct
O = Incorrect

Reinforcer	Phase	Step	Trials 1	2	3	4	5	6	7	8	9	10	Comments	Date
Raisin/ Social	IV	2	O	X	O	O	O	X	O	X	X	X		2/4
Raisin/ Social	IV	3	O	X	O	X	X	O	X	O	X	O		2/5
	IV	3												2/6

Table 10
Pattern of Data Suggesting a Probe Ahead

Teaching Research Infant and Child Center Raw Data Sheet

Name:_____ Program:_____

X = Correct
O = Incorrect

Reinforcer	Phase	Step	Trials 1	2	3	4	5	6	7	8	9	10	Comments	Date
Social	IV	1	O	O	X	O	X	O	X	X	X			2/4
Social	IV	2	O	X	O	X	X	X						2/5
Social	IV	3	X	O	X	X	X							
Social	IV	4	X	X	X									2/6
Social	IV	5	X	X	X									

Table 11
Updating Showing Decision to Probe Ahead

Teaching Research Infant and Child Center Raw Data Sheet

Name:_____ Program:_____

X = Correct
O = Incorrect

Reinforcer	Phase	Step	Trials 1	2	3	4	5	6	7	8	9	10	Comments	Date
Social	IV	1	O	O	X	O	X	O	X	X	X			2/4
Social	IV	2	O	X	O	X	X	X						2/5
Social	IV	3	X	O	X	X	X							
Social	IV	4	X	X	X									2/6
Social	IV	5	X	X	X									
Probe	IV	8-6	8/	7/	6/									2/7

Table 12
Pattern of Data Showing Intermittent Success
and Suggesting a Change of Reinforcer

Teaching Research Infant and Child Center Raw Data Sheet

Name:_____ Program:_____

X = Correct
O = Incorrect

Reinforcer	Phase	Step	Trials 1	2	3	4	5	6	7	8	9	10	Comments	Date
Social	II	2	X	O	X	X	O	X	O	O	X	O		2/4
Music Box/ Social	II	2	O	O	X	X	O	O	X	O	X	X		2/5

Table 13
Updating Showing Decision of Teacher
to Change Reinforcer

Teaching Research Infant and Child Center Raw Data Sheet

Name:_____ Program:_____

X = Correct
O = Incorrect

Reinforcer	Phase	Step	Trials 1	2	3	4	5	6	7	8	9	10	Comments	Date
Social	II	2	X	O	X	X	O	X	O	O	X	O		2/4
Music Box/ Social	II	2	O	O	X	X	O	O	X	O	X	X		2/5
Raisin/ Social	II	2												

Table 14
Pattern of Data Indicating Necessity for Branch

Teaching Research Infant and Child Center Raw Data Sheet

Name:_____ Program:_____

X = Correct
O = Incorrect

Reinforcer	Phase	Step	Trials 1	2	3	4	5	6	7	8	9	10	Comments	Date
Raisin/ Social	IV	1	O	O	O	X	O	O	O	O	O	O		2/5
Raisin/ Social	IV	1	O	O	O	O	O	O	O	O	O	O		

(1) Adding steps to made the behavior smaller. For instance, if Step 3 of a motor sequence required a child to sit unassisted for 5 seconds and Step 4 required the child to sit unassisted for 10 seconds, and the child was able to accomplish Step 3 but not Step 4, a branch might be indicated. The branch could reduce the size of the requirement by adding steps as follows:

Original Sequence	Branch
3. 5 seconds	3a. 6 seconds
4. 10 seconds	3b. 7 seconds
	3c. 8 seconds
	3d. 9 seconds

(2) Adding additional cues by providing additional nonverbal support. For instance, a child is in a self-feeding program, the final steps of which are:

9. Release hand as food is scooped, and return spoon to dish.
10. Child scoops food himself and returns spoon to dish.

The child has reached criterion on Step 9 and has been on Step 10 for two days with no successes. The teacher decides to branch and inserts steps providing additional physical support for the child. The steps are entered on the behavioral sequence sheet as follows:

9a. Child scoops food with adult's hand on his wrist.
9b. Child scoops food with adult's hand on his forearm.
9c. Child scoops food with adult's hand holding his elbow.
9d. Child scoops food with adult touching his elbow.

(3) Adding additional cues by providing additional verbal support. For instance, in the feeding program shown above, a branch could have been written which provided an additional verbal cue instead of physical prompting. That branch would appear on the behavioral sequence sheet as follows:

9a. Child scoops food upon verbal cue, "scoop."

Of course it is also possible to have a combination of verbal and nonverbal branches. Certainly in the example being used here, the child could be physically assisted with the task and also verbally cued.

To document the branching, the teacher must write the necessary additional steps on the behavioral sequence sheet and indicate the sub-step on the data sheet in the "Step" column (Table 15). The entry on the data sheet will then cue the volunteer who is going to teach the program to refer to the behavioral sequence sheet.

When branching a program the teacher must ensure that the reinforcer should be the most powerful available. Although the data pattern may indicate branching, these patterns can only be considered as clues to efficient programming. They are not fool proof indicators. Therefore, prudence would dictate that a teacher faced with data indicating poor or no performance would use a more powerful reinforcer.

Table 15
Updating Showing Decision to Branch a Program

Teaching Research Infant and Child Center Raw Data Sheet

Name:_____ Program:_____

X = Correct
O = Incorrect

Reinforcer	Phase	Step	Trials 1	2	3	4	5	6	7	8	9	10	Comments	Date
Raisins/ Social	IV	1	O	O	O	X	O	O	O	O	O	O		2/5
Raisins/ Social	IV	1	O	O	O	O	O	O	O	O	O	O		2/6
Raisins/ Social	IV	1a												2/7

There is one other type of branching: substituting materials. Frequently, certain materials are used with programs. The teacher may determine that other materials are more suitable for conducting the program with a particular child. Therefore, he or she may revise the program by substituting new materials. This substitution may require nothing more than a notation on the individual cover sheet, but it might also require changing the behavioral sequence sheet. The teacher may also change the verbal or visual cue presented to the child.

Probe Backward. When faced with the possibility of branching, there are certain possibilities the teacher must consider. The poor performance of the child, for instance, may be due to erroneous data at the previous step. Therefore, the teacher should probe the previous step to ensure that the child can accomplish it. If the child can perform the previous step, then the branching is warranted; if the child cannot, he or she will have to be moved back in the program until he or she can accomplish the step.

Another possibility is that the criterion level for moving to the next step may be set too low for overlearning to occur and the child may therefore "forget" the skill learned on the previous day. If this phenomenon occurs more than once in a particular curricular area, the criterion for moving to the next step should be raised. For instance, if the criterion was three consecutive responses before moving to the next step, it probably should be raised to five consecutive responses. This type of updating requires a change on the individual program sheet.

Temporarily Cancel the Program. If a program is not succeeding and the teacher has used all the most powerful reinforcers known and has branched the program in as many ways as he or she can determine, the program should be discontinued. Cancelling a program is an appropriate educational decision since the teacher has exhausted the modifications he or she knows for a particular program. To keep the child in the program at that point would only maintain continuous failure. Therefore, it is better to temporarily cancel the program, place the child in another program and return to the cancelled program at a future time.

Conclusion

The purpose of this chapter has been to present a procedure for measuring the acquisition of self-help skills and to suggest means for conducting placement testing and for collecting and using continuous performance data. It should be kept in mind that a moderately or severely handicapped child, by nature of his or her handicap, will be slow to acquire many of these skills. As educators of this child, we have a responsibility to do everything possible to offset the effects of the handicap. We can do so by providing the child with as many skills as possible through efficient teaching. To assure optimal learning and most efficient teaching, we must conscientiously endeavour to collect and evaluate ongoing data regarding the effects of our programs on the child's learning and to make changes in the child's program as a result of our analysis.

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DATA BASED PROGRAM CHANGE DECISIONS*

Owen R. White & Norris G. Haring

Teachers of young handicapped children have available a variety of options to measure the performance of children in their classrooms. Professionals who are highly trained to work with the handicapped in preschool settings routinely use one or more performance measurement systems. However, how effectively teachers use the data collected with these systems to increase the accuracy of their instructional decisions has been an underemphasized issue. Clearly the main reason for collecting and analyzing data is to predict which intervention tactics can be used to improve performance and increase the number of desired behaviors. Yet social scientists and educators have not invested a great deal of time and energy to develop useful rules for making better instructional decisions. The purpose of this chapter is to report on a set of rules developed during a series of research projects conducted at the University of Washington to enable teachers to make accurate program decisions based on the data they collect in the classrooms.

Background

In the beginning there was nature, and nature taught the child all he or she needed to know. If the child failed to prosper and progress under nature's tutelage, he or she simply ceased to exist. It was rather an all or nothing, inflexable system. It was such an effective system, however, that it changed surprisingly little until very recent times. True, as human beings became more "civilized" they developed more effective means for supporting their basic existence, but from an educational standpoint, they remained quite complacent. If a child failed to learn under a given educational system, he or she was simply dismissed--perhaps to a "special school," where less complex skills were taught, or to an institution, where very little other than the basic autonomic functions of the body were expected or encouraged. Eventually, certain compassionate and open-minded people began to realize that children who failed to do well in a typical educational system might still succeed if alternative appoaches were explored. Schools for the deaf, the blind, the orthopedically handicapped and even the mentally retarded began to emerge. The system began to respond to the needs of the children, rather than to demand that children adapt to the needs of the system.

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Initial attempts to adapt educational approaches to meet the needs of the child were centered on the notion that children, while not all alike, could still be classified into relatively homogeneous subgroups. If a child was blind, he or she needed "mobility" training. If a child were deaf, certain adaptations were required in communication training. If a child were crippled, various occupational therapy or physical therapy approaches would be advised. If a child were mentally retarded, the curriculum would be watered down, a ceiling on expected development would be imposed and basic skills would be drilled in endless repetition. Each approach was, in retrospect, still likely to be somewhat inflexible, but at least it represented some attempt to meet the needs of the child. It was a start.

In the last 15 or 20 years, attempts to identify appropriate educational strategies based on observable child characteristics have become refined and sophisticated. In what has become known as "diagnostic/prescriptive teaching," extensive and detailed assessments are conducted to evaluate the child's physical well-being, current level of performance in a wide range of skill development areas and, perhaps, the child's reaction to various instructional procedures and environmental conditions (White, 1980). The precision with which potentially effective instructional programs can be identified has improved dramatically. As traditionally practiced, however, even the diagnostic/prescriptive approach to program development is still relatively inflexible after the program has been implemented. The child might be reassessed every few months or at the end of the year, but between those infrequent assessments, programs are generally conducted in a consistent and unchanging manner. It wasn't until the mid-1960s when the notion of more frequent assessments (allowing more frequent revisions of prescriptions) began to to take hold.

In an article entitled the "Direct measurement and prothesis of retarded behavior", Lindsley (1964) suggested that teachers might successfully apply basic behavioral methodology in their classrooms. That is, if teachers were carefully to document the conditions under which instruction takes place and monitor their children's progress daily, then they would able to identify promptly needs for revising the program and to assess precisely the effectiveness of each new program. For the most part it worked, and today there are literally thousands of teachers, parents, children and other people using what has become known as "Precision Teaching". In essence, Precision Teaching is a set of guidelines for describing behavior, the instructional plan or conditions under which the behavior occurs; monitoring the frequency (rate) with which the behavior occurs; charting the children's progress on a standard "behavior chart"; and describing and analyzing the changes which occur in the children's progress with each new version of the instructional plan.

The feedback which Precision Teaching and other approaches to monitoring children's progress provide concerning the effectiveness or ineffectiveness of different instructional approaches can be very powerful in helping teachers to "shape" their own behaviors and become more responsive to the individual needs of each child. If a child's performance is improving, the program can be left alone. If the child's performance is "flat" (not changing) or changing in the wrong direction, the program should be revised. . . and revised again. . . and again, until the child begins to make satisfactory progress in the right direction. Although the concept seems simple, there are times when it apparently is not simple enough.

One of the advantages to Precision Teaching is its highly standardized, uniform approach to monitoring and charting the course of a child's progress. Since the same type of chart is used to display all of the programs one might be running, it is possible to make quick and meaningful comparisons among programs and to develop a "feel" or "expectancy" for the way successful programs should work. Such an overview facilitates the formation of progress standards and, in turn, makes it easier for teachers to spot programs that need to be revised. It takes time to

develop those expectancies and standards, though, and many teachers simply don't work with the system long enough to reach a point where it becomes truly useful. Even for teachers who have developed standards and expectancies, the charted record of a child's progress can sometimes be difficult to interpret. Children don't always just "march up the chart" in a nice, orderly fashion. They may progress for several days in a row and then "backslide." Some children's performances are so erratic that it's difficult to determine whether the program is working or not. Finally, even if it becomes obvious that a program is not working as it should, many teachers cannot readily identify what they must change. The net result of these problems is that even when teachers faithfully monitor and chart the child's progress every day, certain ineffective programs may be continued ad nauseam. That's not very pleasant for the child or the teacher.

The evaluation rules discussed in this paper were developed over a period of about ten years in an attempt to correct these problems of data collection and analysis. Specifically, they were developed as an extension of the Precision Teaching approach to help teachers make more timely and effective decisions about when a program should be changed and how a program should be changed. Before discussing these rules, it is important to point out that they do not replace the basic procedures of Precision Teaching (i.e., the rules for identifying behavior, monitoring it and using the standard behavior chart). The new rules only expand Precision Teaching to make it more immediately and consistently effective as a feedback mechanism for teachers. It will help, therefore, to begin with an overview of the basic Precision Teaching tenets.

Some Basic "Givens"

In order to derive the greatest benefit from the rules which will be discussed in this paper, the following practices must be employed. For a more complete description and discussion of each practice, the reader should consult one of several available books on Precision Teaching (e.g., Kunzelmann, Cohen, Hulten, Martin & Mingo, 1970; Pennypacker, Koenig & Lindsley, 1972; White & Haring, 1980). A more complete list of desirable "givens" may also be found in Haring, Liberty and White (Note 1).

Focus on Directly Observable Behavior

In order to form a clear and unambiguous picture of child progress, it is important to focus evaluative efforts on concrete, directly observable behaviors. In some cases, as in a program designed to increase a child's skill in pulling to stand from a kneeling position, the behavioral target will be obvious. If the program is designed to improve what Lindsley has called a "private" or "covert" behavior (e.g., developing a "positive attitude"), some attempt must be made to identify directly observable concomitants. This identification can usually be accomplished by asking which of the child's movements or physical actions appear contraindicative of the program's aim, and which movements the child would be likely to make if the project's aim were met. For example, in attempting to set up a home program to improve a child's attitude, the teacher might first ask the parents to describe the specific actions the child now makes which lead them to believe there is a problem (e.g., making negative or derogatory statements or refusing to comply with simple requests). Then, the parents should describe the specific actions the child might make more often to show an improvement in attitude (e.g., making positive or complimentary statements or complying quickly with simple requests).

The final list of behaviors used in tracking the child's progress in a program should be rather small. The purpose of specifying directly observable evaluation targets is not to exhaust all possible ways in which a particular skill or program goal might be demonstrated, but only to provide a reasonable, manageable focus to the evaluation. If, when the program begins, it becomes apparent that the initial list of target behaviors does not adequately reflect the true problem or intent of the program, the list can be changed. The process of specifying, trying and refining evaluation targets can, in fact, prove quite useful in itself as a way of more clearly defining the true nature of a problem or program goal; the process can also help teachers and parents to develop more discriminating observational skills.

Build Behavior

The primary function of a teacher is to help each child build new skills or refine old skills (e.g., to tie shoes, to identify numbers or to improve speech patterns). The rules which will be discussed in this paper were designed to help the teacher make the right decisions with regard to building and refining new skills. If the teacher also finds it necessary to "manage" certain behaviors (e.g., to decelerate "self-stim" or "aggressive behavior"), the rules discussed in this article may still be of help in deciding whether a program is working, but they will not be of much help in deciding what type of program revision to try if the child is not progressing satisfactorily. Other chapters in this monograph will focus on "behavior problems." This chapter will focus on "skill building."

Provide Opportunities for the Pupil to Demonstrate the Behavior

In order to assess accurately a child's progress in building or refining a skill, the teacher must first give the child an opportunity to practice and demonstrate the skill. While natural circumstances may provide a reasonable number of opportunities for the demonstration of some skills, there are few if any situations where opportunities cannot be improved upon. Even in toileting programs, for example, it is possible to increase the number of opportunities for practice by encouraging the ingestion of larger than normal amounts of liquid. As a rule of thumb, one should try to set up situations where the skill can be practiced and evaluated at least ten times a day. With some skills (e.g., toileting) this may mean devising a system for monitoring the behavior throughout the entire day. With other skills (e.g., identifying various objects by name), situations might be arranged which allow the behavior to be practiced and assessed many times within the span of a few minutes. If fatigue, interest level or attention span seems to be a problem, practice could be divided into several short periods spaced throughout the day.

Setting up situations which allow a skill to be demonstrated many times is advantageous in at least two respects. First, daily evaluations based on many attempts to demonstrate the skill are likely to be reasonably accurate estimates of the child's true ability. If evaluations are based on only one or two demonstrations of the skill, a single "lucky guess" or "lapse in attention" could drastically affect the results of the evaluation. Second, the old adage of "practice makes perfect" is very often true. If a child has only one or two opportunities to practice a skill each day, rates of progress are likely to be far lower than if more opportunities are provided for practice (White & Haring, 1980).

In light of the above, it is somewhat distressing to note that many teachers provide only infrequent and/or inconsistent opportunities for practice. In a study of some 81 teachers working with the severely handicapped, for example, Haring, Liberty and White (Note 2) found that only about 50% of the teachers provided daily practice for instructional targets, and 14% of the teachers provided practice time for their instructional programs only once or twice each

week. When programs were conducted, only 51% of the teachers provided ten or more opportunities to demonstrate the skill during the session; and 30% of the teachers reported that they usually provided less than five opportunities to demonstrate a skill during any given session.

If a skill does not occur often enough for precise evaluation, it is usually possible to redefine the evaluation target in terms of some behavior which occurs more frequently. For example, instead of simply noting whether a child eats his or her entire lunch without spilling, individual "bites with spilling" could be counted to provide a more sensitive measure of the child's progress. In cases where a child simply has more programs than can be run on any single day, the obvious solution is to concentrate on fewer programs. When the goals for those fewer programs have been reached (and they should be reached more quickly, because of the greater concentration of errors), the teacher can add or substitute other programs.

Collect Information Concerning both Count and Time

Traditionally, teachers monitor only the number of correct and incorrect behaviors a child displays during an assessment; they then normally translate those counts into a "percentage correct" statement which describes the child's accuracy. For reasons which will become more apparent later in this article, accuracy or percentage data alone will not usually be sufficient for choosing the most effective instructional procedures. Information is also needed concerning the child's fluency, or the "ease" with which he or she is able to complete the task. The most common method for assessing fluency is to count correct and incorrect behaviors, to time the entire assessment session and then to divide the counts by the time to find the child's "correct rate per minute" and "error rate per minute." In some cases, latency (timing how long it takes a child to begin to respond) or duration (how long it takes to complete each response once it begins) information will be more useful. The rules presented in this paper relate only to rate, but rules for other time-based types of data have also been developed (C.V., Haring, Liberty & White, note 1).

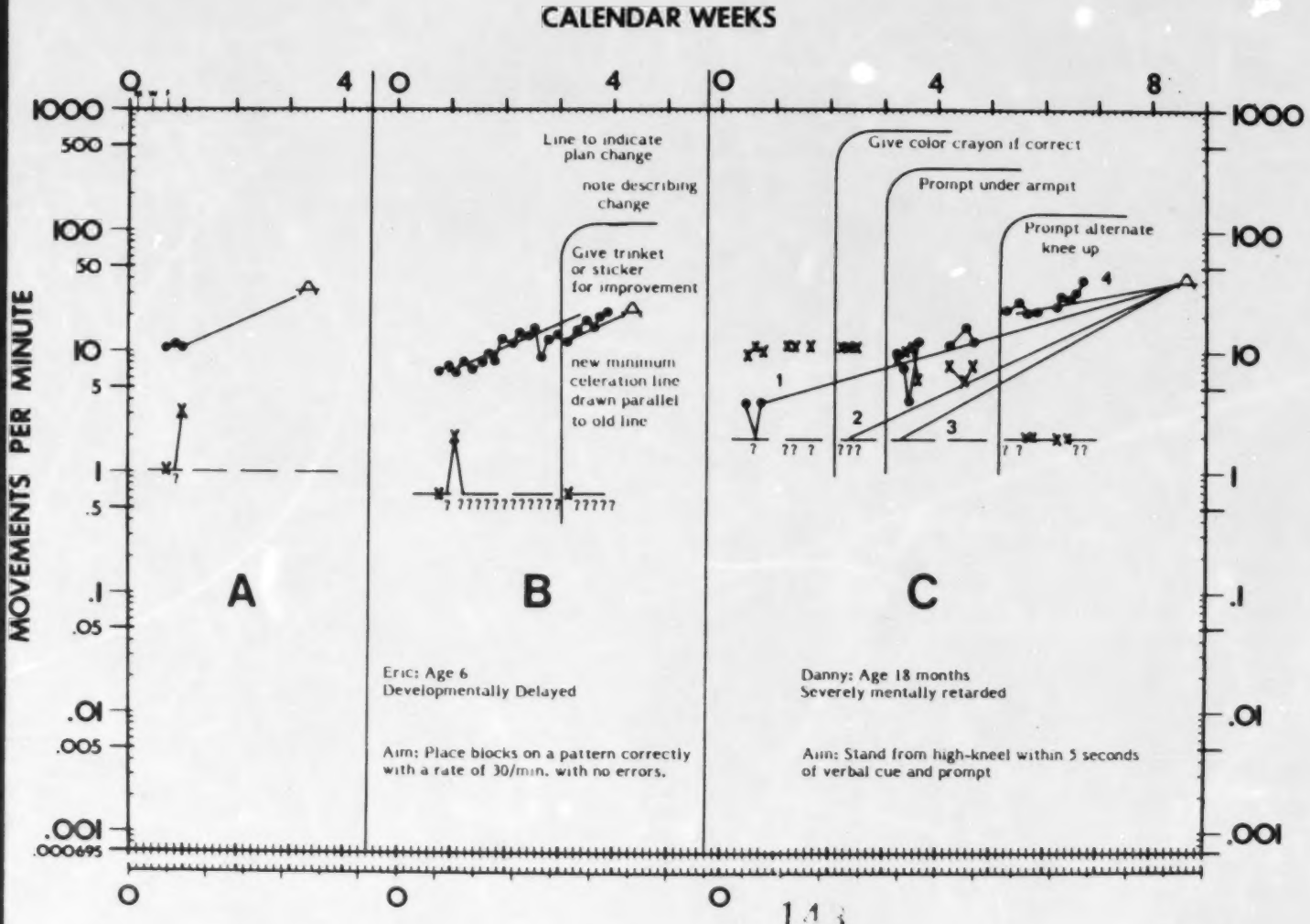
Chart the Pupil's Progress

Most of the rules for deciding when and how to change programs require that the teacher have a clear picture of the child's day-to-day progress over at least the last week and frequently for longer periods. The easiest way of forming that picture is to keep a simple chart of assessment results. The rules discussed below were originally developed using the standard behavior chart originally developed by O.R. Lindsley and C.H. Koening and available from Behavior Research Company, Box 3351, Kansas City, KS, 66103. The rules are expressed in terms which require the same type of chart to be used. Although the rules might be adapted for use with other types of charts (or, indeed, no chart at all), it would most likely be difficult and time-consuming for the teacher to do so.

Set Aims

The rules for deciding when and how to modify instructional programs to make them more effective will only work if the teacher has a clear set of goals in mind. Specifically, it is important that performance goals be established for correct and incorrect behaviors (e.g., sorting shapes correctly at a rate of 30 per minute with two or fewer errors) and that a specific date has been set for reaching those goals. If there are no performance goals, it will be

Figure 1
The Minimum 'Celeration Line



impossible to tell when the child has adequately demonstrated the skill to be taught; and if there is no predetermined timeline, it will be difficult to tell if a child is progressing at an acceptable rate.

Deciding When to Change

In order to determine whether a program needs to be refined to better meet the needs of the child, some standard for acceptable child progress must be established. The simplest and most useful way of establishing that standard is to find what Liberty (1972) calls the "minimum 'celeration line." "Celeration" is the root of the words acceleration and deceleration--the two ways in which the frequency of a behavior can change. Minimum celeration, therefore, refers to the least amount of behavior change a child must make each week in order for a program to be considered successful.

Finding the Minimum 'Celeration Line

Draw an aim star on the chart. The instructional aim is indicated on the chart by drawing a star at the intersection of the performance aim and the date on which the child should achieve that aim. For example, if the instructional aim is to raise the child's correct rate to a level of 30 correct behaviors per minute within three weeks, the star would be drawn at the intersection of the line which represents 30 per minute on the chart and the line which represents a date three weeks from the present.

Complete three daily assessments of the skill. Any single assessment of a child's skill may be misleading. The child may not feel well on any given day, or perhaps it takes a little time for the child to understand what the teacher wants him or her to do. In any event, in order to get a reasonably accurate picture of the child's actual skill at the beginning of the program, it is advisable to assess the child for at least three days.

Draw a "start mark" to indicate the child's initial skill. The results of the first three assessments are summarized by drawing a little circle, or "start mark" at the intersection of the middle (second) day of the three assessments and the middle (second to lowest or highest) performance value.

Draw the minimum 'celeration line. Having noted where the child should end up (the aim star) and where the child is now (the start mark), it is a simple matter to describe how rapidly the child will have to progress to get from one point to the other. Just draw a line from the start mark to the aim star. That line does not necessarily describe how rapidly and child will progress, but it does establish a minimum standard for acceptable progress if the child is to reach his or her aim within the time available. Figure 1A shows the minimum 'celeration line drawn from the middle of the first three assessments to the aim star.

Using the Minimum 'Celeration Line to Decide If and When a Program Change Should Be Made

Continue to monitor the child's progress. Assess the pupil as often as possible and chart the results.

If the child falls below the minimum 'celeration line for three days in a row, change the program. The child's performance may fall below the line for one or even two days, but the child may still have little or no difficulty in reaching his or her aim. Experience has shown, however, that if a child's performance falls below the minimum 'celeration line for three days in a row, there is less than a six percent chance that the child will still reach the aim by the date established--unless a change in the program is made (Liberty, 1972; White & Liberty, 1976) (see Figure 1B).

Change the program. Revise the instructional plan and implement the new program as quickly as possible (rules for deciding what to change will be discussed later). Note the change on the chart by drawing a heavy vertical line just before the day when the new program was put into effect and briefly describe the change.

Draw a new minimum 'celeration line. Since the child has already failed to meet the old minimum 'celeration line, it will be necessary to establish a new standard for progress. If the date for achieving criterion can be extended somewhat, the new line might be drawn from the child's current level of performance, parallel to the old minimum 'celeration line, until it crosses the previously established performance aim as in Figure 1B. Figure 1B shows the line formed when a program is changed after three assessments in a row fall below the minimum 'celeration line. In this case, a new minimum line is drawn parallel to the old one, moving the aim date farther into the future.

If the date cannot be changed, then draw the new 'celeration line from the current level of performance to the old aim star as in Figure 1C. In Figure 1C we see a series of changes, with each new minimum 'celeration line drawn to the original aim star. After any change is made, daily assessments are continued and the rules described above are used with the new minimum 'celeration line to determine if any further changes are needed.

Does the Minimum 'Celeration Line Really Help

It would appear that the minimum 'celeration line can significantly improve the chances that timely decisions will be made about the need for program revision; in turn, those decisions will result in greatly improved child progress. In one study (Bohannon, Note 3), teachers were more than five times more successful in remediating skill deficits when they employed the minimum 'celeration line that when they did not. In another study, children in classes using the minimum 'celeration line consistently achieved higher rates of progress than similar children in classes where those procedures were not used (Mirkin, Note 4). A similar procedure has even been used successfully to improve the session-to-session progress of outpatients in a behavior therapy program (Lloyd, Mitchell, Realon, & McKinney, 1981).

Deciding What to Change

If and when a program change becomes necessary, there are several different ways in which the program might be revised. The most common strategies include:

1) stepping back to a more basic, easier skill;
2) revising instructions, cues, prompts, materials or feedback and correction strategies in an attempt to provide the child with more information about how the task should be completed and what is expected of him or her;

3) providing more powerful reinforcers or consequences in an attempt to increase or maintain the child's incentive to work as well as he or she is able; or

4) stepping ahead to a more advanced skill and assuming that the child has really mastered the skill in question and only needs "greater challenges."

Any teacher is likely to prefer one or two of the strategies listed above and only try an alternative if the preferred strategy meets with consistent failure. The most commonly preferred strategy is stepping back (Haring, Note 2), possibly because it is more comforting to assume that the child needs something easier, rather than to question the effectiveness of the basic instructional plan. However, no single strategy is likely to be consistently successful, and even if a plan meets with initial success in promoting child progress, it may lose its effectiveness as the child's performance changes. The decision rules discussed below have been designed to assist the teacher to identify the actual instructional needs of the child at any given point in time and to select the type of program revision which is most likely to meet the child's current needs.

Phases of Learning & Changing Instructional Needs

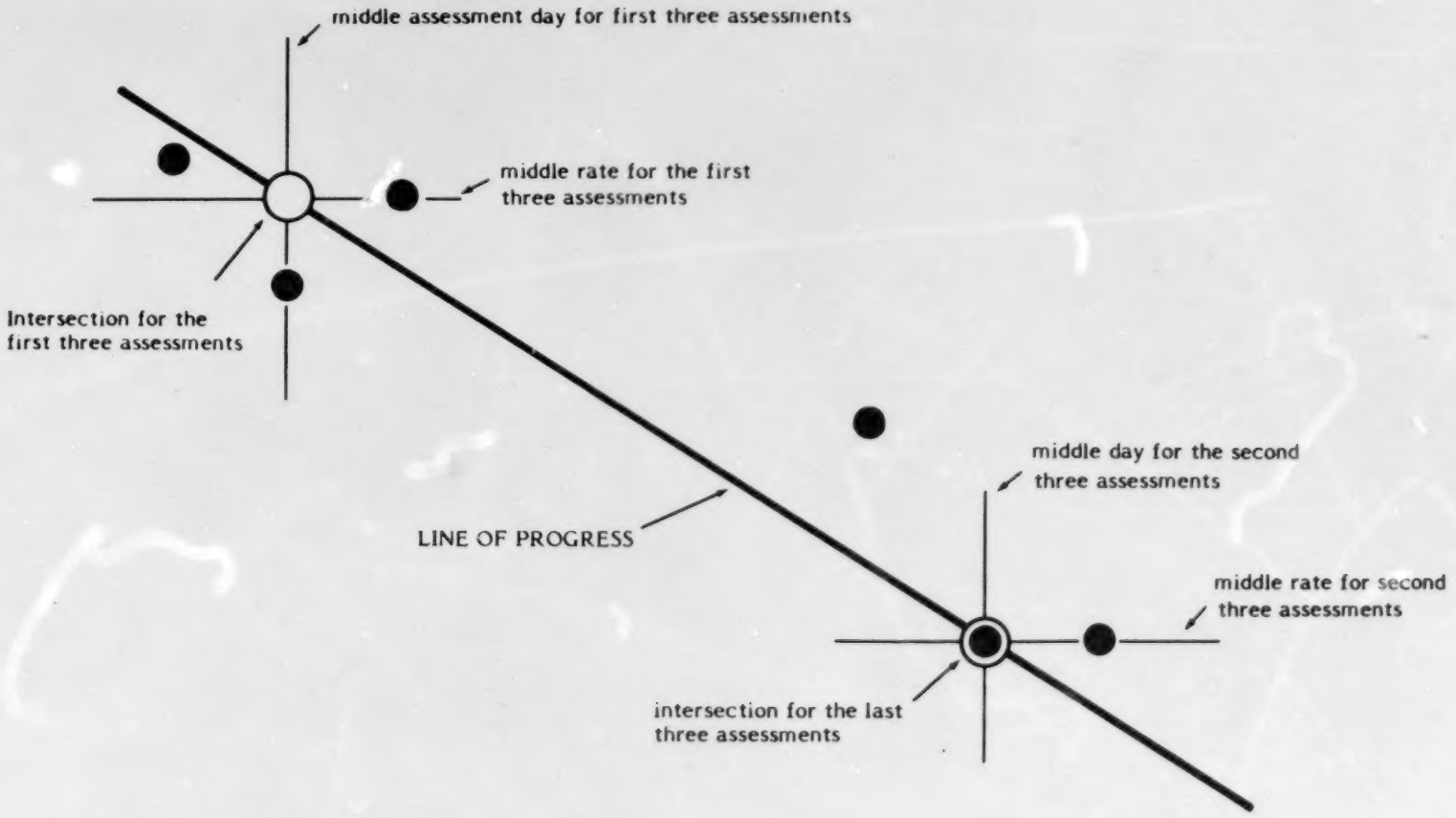
In order to truly master any given skill, a child is likely to pass through at least two different phases of learning: acquisition and fluency building. Each phase involves a different type of learning and, in turn, may require different instructional approaches.

Acquisition. At first, a child must acquire basic competence in performing the skill correctly--he or she must learn how to perform the task. If the child runs into difficulty during this phase of learning, revisions in the instructional plan designed to provide the child with more information (e.g., cues, prompts, corrective feedback) are most likely to be successful. This is not to say that "motivation" may not be a problem, but arranging only for more powerful reinforcers when the child simply does not know what to do is very unlikely to be sufficient for continued progress.

Fluency-Building. It is not usually enough for a child simply to know how to perform a skill. Practice with the skill must generally continue until the child can perform the task well enough to make it truly useful. The level of fluency required with a skill is usually dependent upon some form of competition, but not necessarily in the traditional sense of the word. Competition with peers may play a role with some skills (e.g., athletic or academic games), but more often than not, the fluency standards for most of a preschooler's skills will be determined by adults or the fluency with which the child is able to demonstrate other skills. For example, if a child's parents have only about 15 minutes to see that their child is dressed before they leave for work, then the child must meet that fluency standard or the parents will simply not allow the child to use the dressing skill. Similarly, if it is easier for the child to tie his or her shoe laces in a knot than to struggle through a bow, the knot is likely to prevail.

Drill is usually the most effective way of building skill fluency. The child is simply asked to perform the task over and over again. The problem with drill is that it can be boring. If the child appears to be having difficulty during the fluency-building phase of learning, therefore, it will probably be necessary to arrange for more powerful reinforcers or consequences--something to make the continued drill worthwhile to the child. Adding more instructional events (cues, prompts, etc.) may just compound the problem. After all, the child knows pretty well what to do, he or she just needs a reason for doing it.

Figure 2
Line of Progress Depicting Average Change


middle assessment day for first three assessments
middle rate for the first three assessments
Intersection for the first three assessments
middle day for the second three assessments
LINE OF PROGRESS
middle rate for second three assessments
intersection for the last three assessments

Identifying the Phase of Learning

Common sense might dictate that a child would be in the acquisition phase of learning until becoming fully successful in completing the task accurately, and that he or she then would pass into the fluency-building phase of learning. If this were true, it would be possible to decide whether strategies for acquisition or fluency-building would work by simply assessing the child's accuracy. Unfortunately, this is not the case. Most children begin to pass into the fluency-building phase before all the steps in a task have been fully acquired. Just because a child does not know all the letters in the alphabet does not mean that he or she cannot begin to build fluency with those already learned. Even the child who has actually acquired all the steps in a task may simply make careless errors out of boredom. It is possible, therefore, that the child reaches a point where strategies appropriate for fluency building (increased consequation) become more important than strategies appropriate for acquisition (increased cues and feedback) long before he or she ever demonstrates complete accuracy. Even if the teacher has no real interest in fluency, therefore, it may become necessary to attend to that phase of learning in order to reach a point where the child reliably demonstrates the skill with an acceptable level of accuracy.

To complicate matters further, it is possible for a child to be completely accurate on some tasks and still not really to have acquired the desired skill. For example, rather than learning how to read a clock, a child may use elaborate counting strategies to determine the time of day. The "clue" most useful in deciding if a child is using an inappropriate strategy is usually the fluency of his or her performance--it takes a lot longer to count dots on a clock than simply to note the relative positions of the hands. More will be discussed about the importance of fluency later; for now it is only important to realize that even if a child is completely accurate in arriving at the correct answer, it might still be advisable to continue with an emphasis on acquisition until a more efficient strategy is learned.

Fortunately, things are not quite as hopeless as they might at first seem. There are relatively simple rules for determining the phase of learning in which a child is currently developing and, thereby, for deciding which type of program emphasis is likely to be be most effective in promoting continued learning. Before these rules can be understood, however, it will be necessary to review a few procedures for describing child performance.

Describing Patterns of Learning*

Four aspects of a child's performance will be important in evaluating his or her needs: the trend or progress in correct performance over the past six assessments; the variability in correct performances; the ratio of correct to incorrect performances; and the overall fluency of correct performances.

Trend in Correct Performances. A line should be drawn through the last six correct performances to indicate whether they are generally increasing, remaining essentially the same or decreasing over time. The procedures which have proved most useful for drawing that line are as follows. Figure 2 shows the line of progress drawn to describe the average change in correct rates over six assessment days. Correct rates are depicted as solid dots; intersections of middle days and middle rates are shown as open circles.

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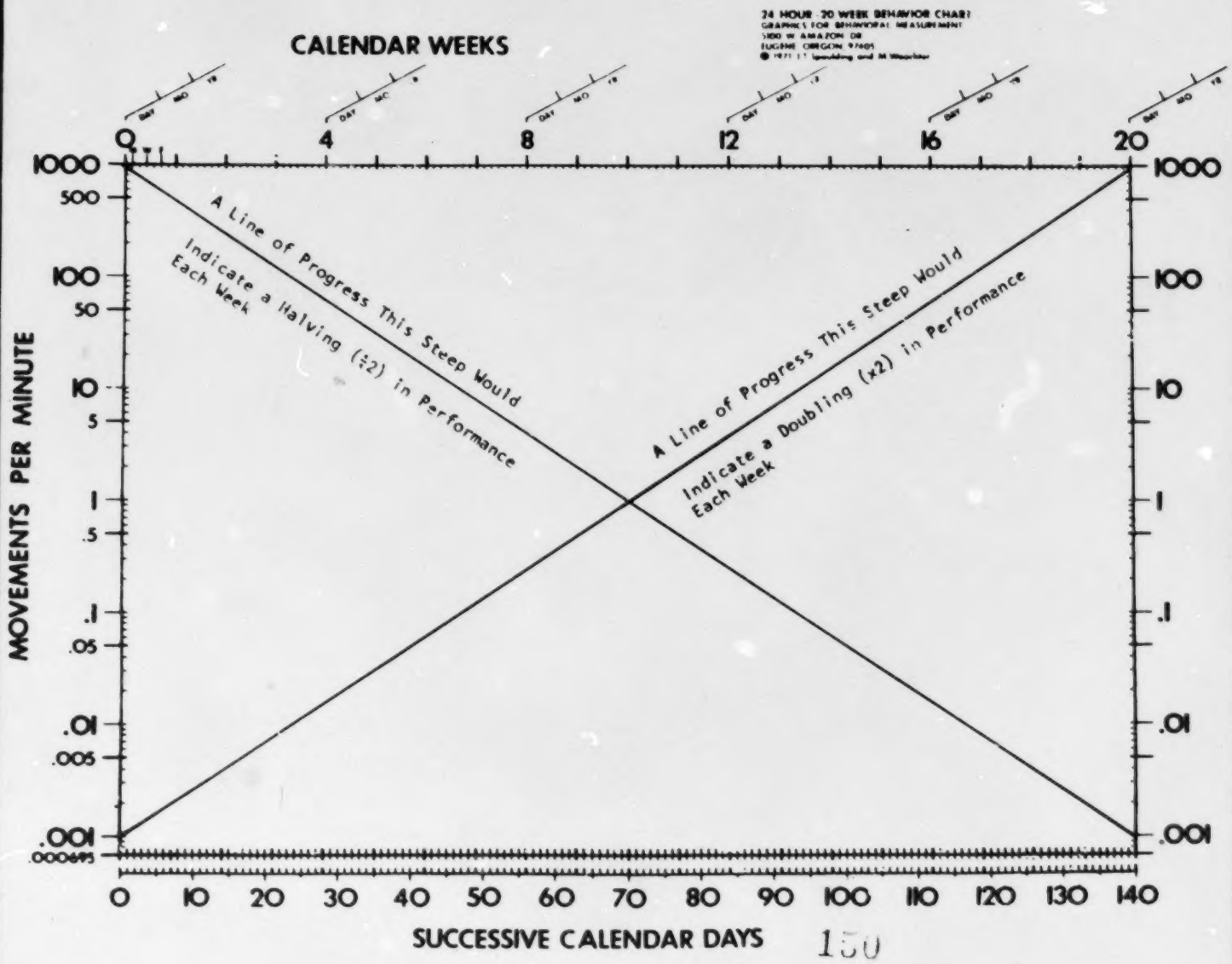
*The patterns of learning described here are similar in concept to the "learning pictures" discussed by O. R. Lindsley at the Big Sky Precision Teaching Conference Kalispeli, Montana, Summer 1977.

Figure 3
Lines of Progress Depicting Halves and Doubling



1) Find the intersection of the middle-day and the middle-performance value for the most current three assessments on the chart. In other words, use the procedures described earlier for finding a "start mark", but use them with the last three assessments instead of the first three assessments on the chart.

2) Find the intersection of the middle-day and middle-performance value for the next three most recent assessments (i.e., the foruth, fifth and sixth most recent assessments on the chart).

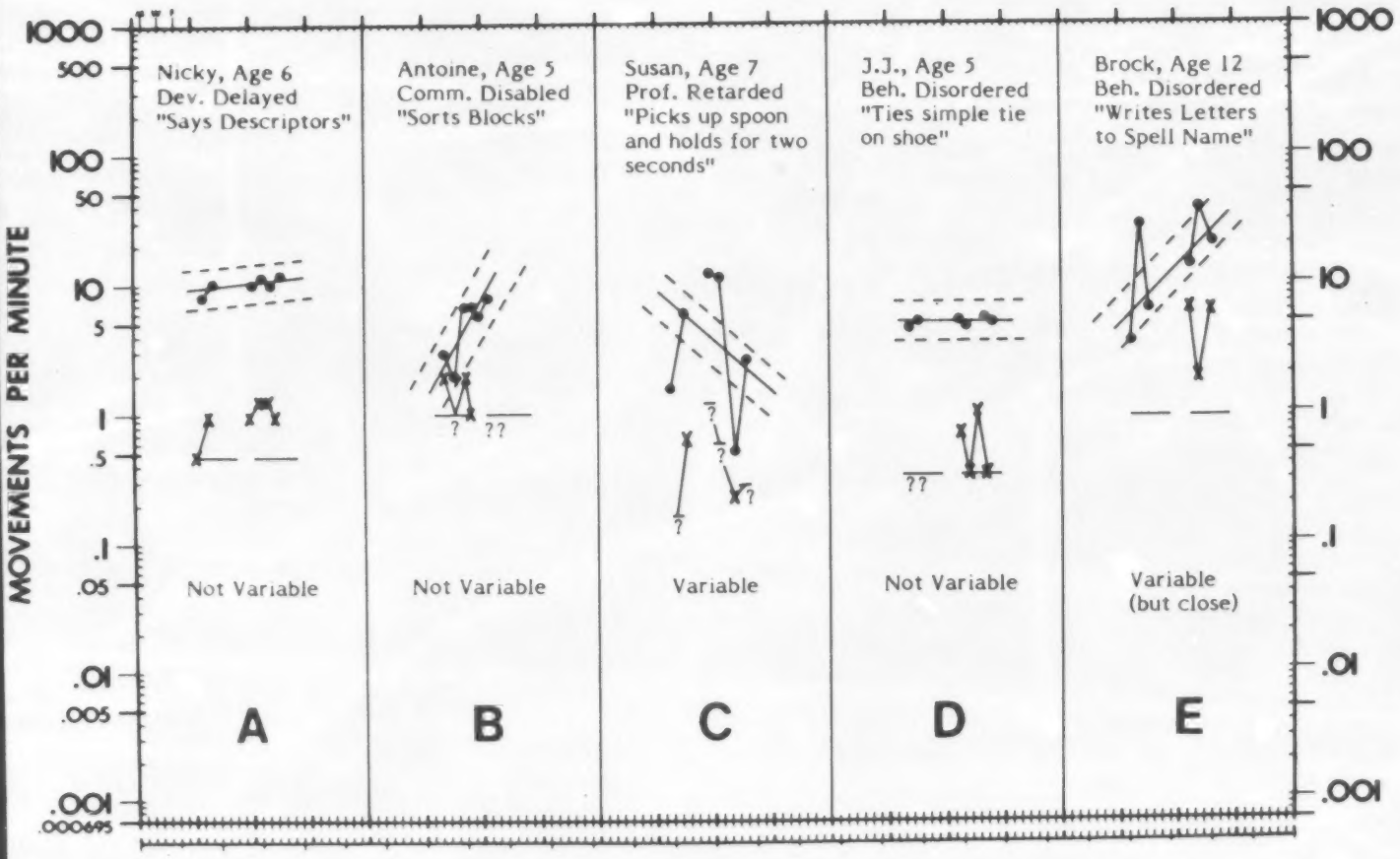
3) Draw a straight line passing through the two intersections found in steps one and two, above. That line will, in most cases, be a fairly accurate estimate of how the correct performances were changing on the average over the past six assessments.

If the line of progress for the correct performances is going up or down the chart, it will be necessary to note whether the slope of that line is "steep." Generally, a slope is steep if it represents a doubling (times-two) or halving (divide-by-two) of performance over any given week. As a point of reference, a straight line from the lower left-hand corner to the upper right-hand corner of the standard behavior chart represents doubling; a line drawn from the upper left-hand corner to the lower right-hand corner represents halving (see Figure 3). By drawing or visualizing these lines on the chart, it is relatively simple to compare the child's actual trend with these standards and determine whether the change in correct performances can be considered "steep."

Variability. Most children have "good days" or "bad days," but overall the change in performance from day to day should be relatively consistent and stable. If it is not, then serious questions arise concerning the "power" of the instructional program to attract the child's attention and best performances. The child's attentiveness will be an important consideration when selecting intervention strategies for improving a program. If the standard behavior chart is being used, there is a simple procedure for deciding whether a child's performance patterns are reasonably stable. Simply place a standard wooden pencil on top of the line of progress and move it up or down to cover as many of the correct performances as possible. If it is possible to cover all but one or two of the correct performances in a one- or two-week period, then the child's performance pattern can be considered reasonably stable. If several correct performances "peek out" from under the pencil, however, the variability of the child's performance should be considered unacceptably high. The heavy solid lines in Figure 4 indicate each child's average process; the dotted lines indicate the width of a standard pencil on an unreduced chart. Panels C and E illustrate unacceptably high variability, since the correct rates could not be covered by a pencil on the standard-sized chart. Panels B, C and E also illustrate progress that exceeds a halving or doubling of rates each week and which would, therefore, be considered steep.

Accuracy. Although most of the information required to identify a child's phase of learning relates only to his or her correct performances, some information will also be required concerning the relationship of correct to incorrect performances. Percentage statements could be calculated for each assessment, but fortunately, if the standard behavior chart is being used, there is a simpler way. Only one of two accuracy levels is likely to be important for determining a child's phase of learning--83% or 67%, depending upon the type of skill or child involved. These two proportions represent, respectively, ratios of five corrects to one error and two corrects to one error. The distance on the standard behavior chart which those ratios represent can be easily determined by looking at the left-hand scale. Whenever correct and incorrect performances are as far apart as the one and the five lines, the child is at least 83%

Figure 4
Variability



accurate. Whenever they are as far apart as the one and the two lines of the chart, the child is at least 67% accurate. By marking these distances on a slip of paper and then passing the paper over the graphs of the child's rates (Figure 5), it can be easily determined whether the child has met either of those two basic accuracy standards (see Figure 5).

Figure 5 depicts the plotting of child accuracy ratios in performing particular behaviors. Brock, in the examples in Figure 5, is the only child to achieve a level of accuracy at least as good as 83% (a ratio of five to one). All of the children in those examples, however, do reach an accuracy ratio of at least two to one, or 67%. Note that the best day is used for each child, regardless of when that day falls. In all of the examples in Figure 5, dots represent correct rates and x's represent errors.

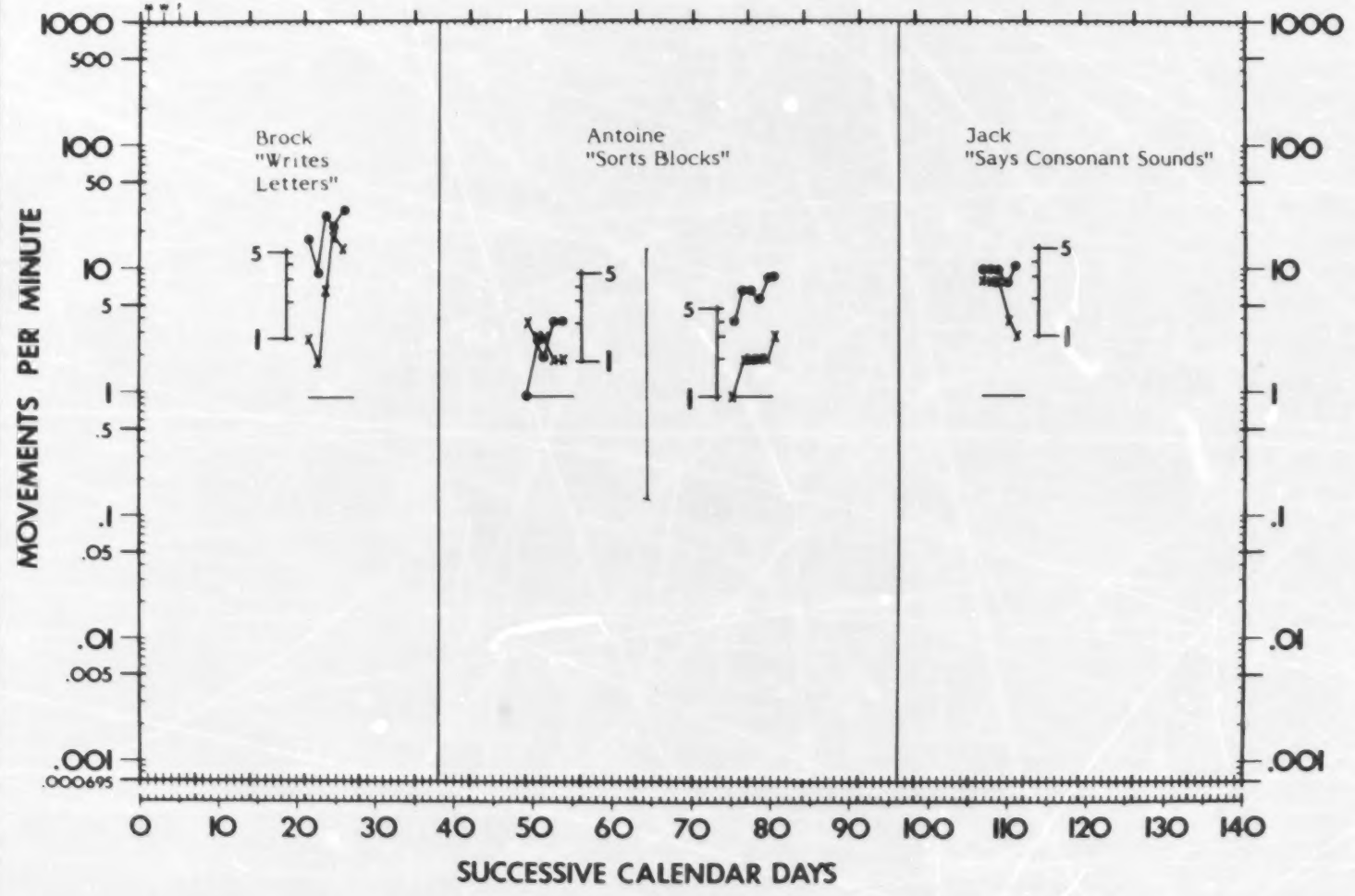
Correct Rate. While it may seem reasonable that a child's correct rate should have some relationship to the point when he or she begins to make the transition from acquistion to fluency-building, one would not expect that transition point to fall at the same rate for skills which have differing fluency standards. For example, young children are usually not considered fluent in saying the alphabet until they can recite it at about 150 to 200 letters per minute (i.e., saying the whole alphabet in eight or nine seconds -- most adults can usually say the alphabet in four or five seconds). A young deaf child might be considered acceptably fluent in signing with a correct rate of only 60 or 70 signs per minute. One would expect, therefore, that children would begin to make the transition into fluency building by saying the alphabet at a higher rate than with signing. This, however, doesn't seem to be the case. If the child is "physically intact" (i.e., is physically capable of reaching the present fluency aim), and if the skill in question is one which a normal, fluent adult is likely to perform at a rate of more than 20 per minute, then the transition from acquisition to fluency building is likely to take place when the correct rates reach 15 to 20 per minute. This rule seems to work for a very wide range of skills--from steps taken while walking, to oral reading; and from sorting blocks to making complex signs. If the skill being taught is one which a normal fluent adult is able to perform at a rate of 20 per minute or more, therefore, it will often be necessary to know whether the child has ever achieved a correct rate close to or above 20 per minute.

The Decision Rules

Once the child's performances have been evaluated in terms of the variables outlined above, it should be possible to make a fairly accurate determination of the child's current phase of learning and, in turn, to choose the instructional strategy which is most likely to promote continued learning. Two sets of rules exist. The first set of rules was developed during the mid-1970s through an analysis of learning records from classrooms serving learning disabled children (White & Liberty, 1976; Haring & White, 1980). Later, the predictive validity of those rules were tested and found to work well with the progress records of several thousand normal children (Sokolove, Note 5). When those rules were applied in classrooms serving the severely handicapped, however, three problems were encountered (Haring, Note 2).

First, many of the instructional target behaviors for severely handicapped children cannot be criterioned at the same high rates as those for mildly handicapped or normal children. Rules concerning the transition from acquisition to fluency building based on the rates of mildly handicapped pupils could not, therefore, be applied to many programs developed for the severely handicapped. Secondly, although mildly handicapped and normal children appear to be able to begin building fluency when a relatively small proportion of a task has been acquired

Figure 5
Accuracy Ratios



(i.e., when they are about 67% accurate), more severely handicapped children apparently need to acquire a larger proportion of the task before building fluency (i.e., they need to achieve about 83% accuracy). Finally, a relatively large proportion of the severely handicapped children studied displayed a great deal of variability in their performances from day to day. Such children tended to be unpredictable until special programs were developed to make them more "compliant" and responsive to the instructional situation. In order to account adequately for the entire range of situations which a teacher might encounter, therefore, it was necessary to develop two sets of rules.

Despite the background leading up to the two sets of rules, the decision to use one set or the other need not depend on the severity of the child's handicap. Many severely handicapped children appear to follow the rules originally developed for learning disabled children, and even a normal child might best fit the rules originally developed for the severely handicapped. Basically, the following guidelines should be used in choosing the set of rules to use with any given program:

1) If the skill in question is one which a normal, fluent adult could perform at a rate of 20 per minute or more and if the child is physically capable of performing at this rate, then the rules outlined in Figure 6 should be used.
2) If the skill in question cannot be performed by a normal fluent adult at a rate of 20 per minute or more, or if the child is physically disabled so that he or she cannot attain this rate, then the rules illustrated in Figure 7 should be used.

Once the appropriate set of rules has been selected, the teacher simply begins with the first box in the upper left-hand corner of the flow-chart (Figure 6 or 7) and moves from one step to the next by answering questions. At some point the answer to a question will direct the teacher to the decision which has demonstrated the greatest chance of success in studies with handicapped children (e.g., Haring, Liberty, & White, Note 1). Each of those basic decisions is described briefly below.

Decision #1: Move to the next step in the program or to another skill.
Once a child has reached the performance aim established for the program, a new and more advanced program should be started immediately. If a program is continued beyond the point of basic mastery, many children will actually worsen, probably as a result of boredom.

Decision #2: Do not make any changes in the program at this time.
If the child is progressing at a satisfactory rate, then the program should be continued without change. Trying to "double guess" the rules and anticipate problems usually leads to a disruption of progress.

Decision #3: Step back to a simpler or less complex skill.
If the pattern of performances clearly indicates that the child cannot make at least a few correct responses in the program, then a simpler, prerequisite skill should be taught. Great care should be taken in jumping to hasty conclusions, however. Studies have shown that if a severely handicapped child can make even one correct response in the first five days of a program, it is probably better to continue instruction at that level than to go to something easier.

Figure 6
Decision Rules for High-Rate Behaviors

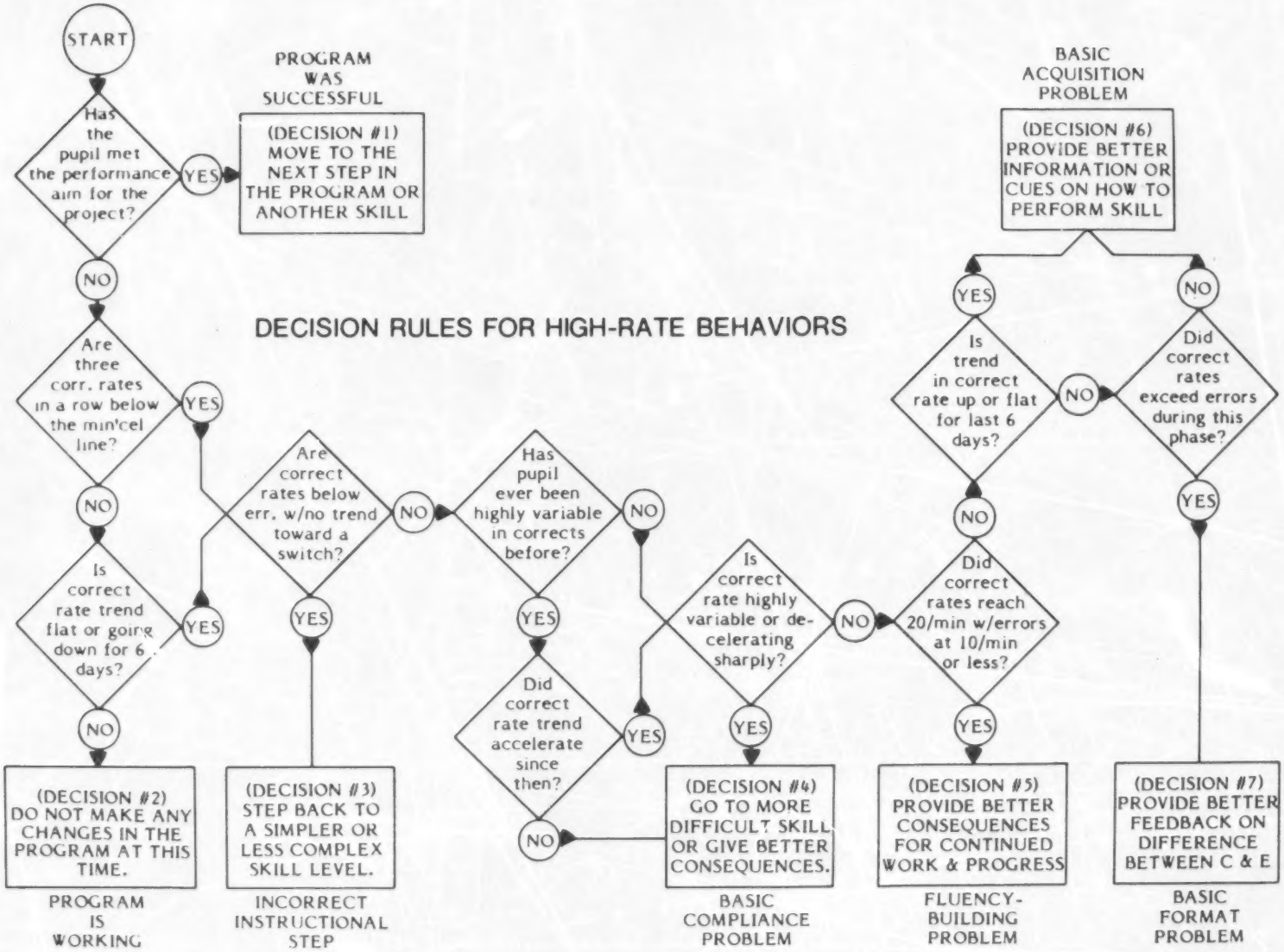
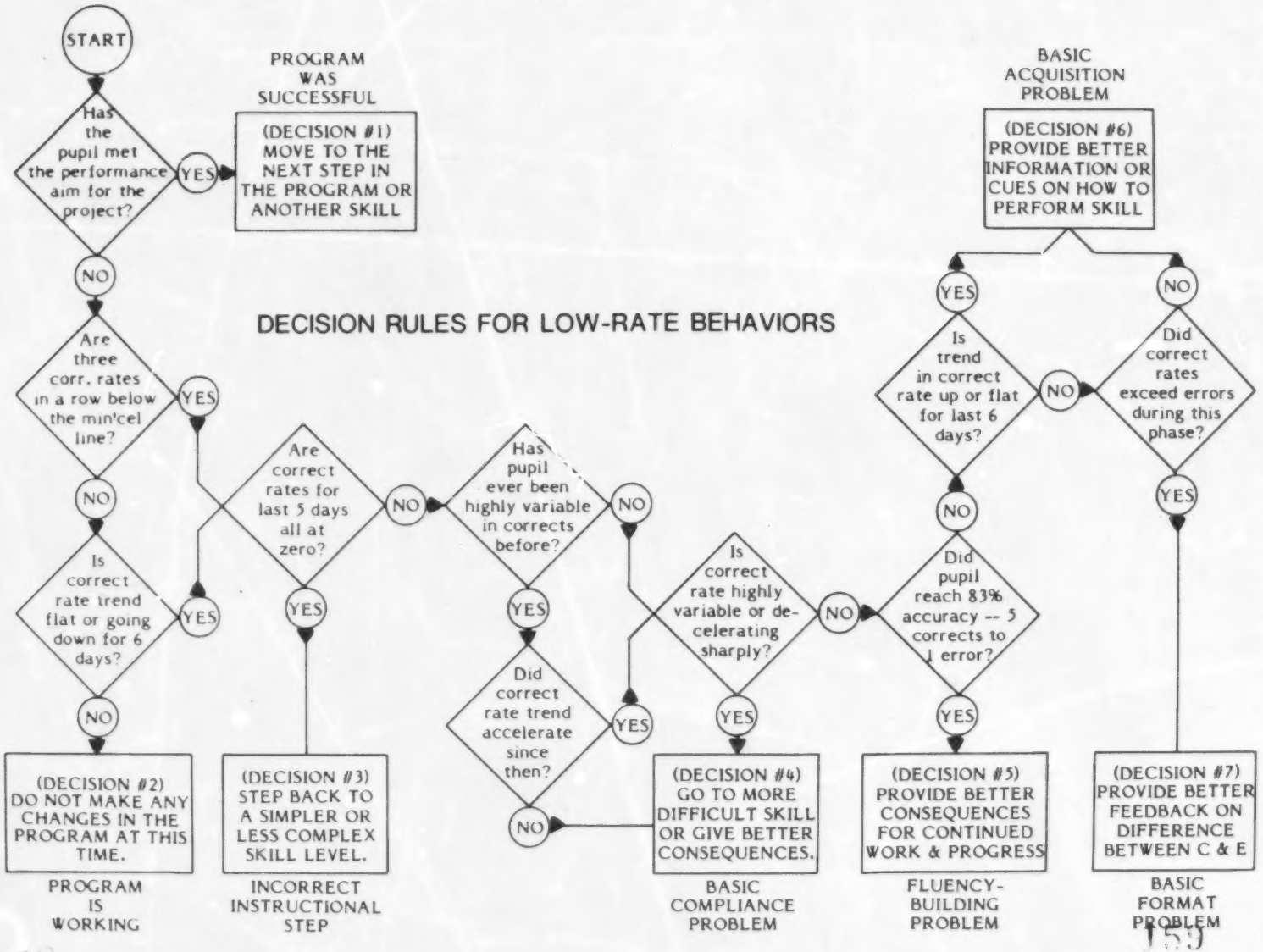

DECISION RULES FOR HIGH-RATE BEHAVIORS
START
Has the pupil met the performance aim for the project?
YES
PROGRAM WAS SUCCESSFUL
(DECISION #1) MOVE TO THE NEXT STEP IN THE PROGRAM OR ANOTHER SKILL
NO
Are three corr. rates in a row below the min'cel line?
YES
NO
Is correct rate trend flat or going down for 6 days?
YES
NO
(DECISION #2) DO NOT MAKE ANY CHANGES IN THE PROGRAM AT THIS TIME.
PROGRAM IS WORKING
Are correct rates below err. w/no trend toward a switch?
NO
YES
(DECISION #3) STEP BACK TO A SIMPLER OR LESS COMPLEX SKILL LEVEL.
INCORRECT INSTRUCTIONAL STEP
Has pupil ever been highly variable in corrects before?
NO
YES
Did correct rate trend accelerate since then?
YES
NO
Is correct rate highly variable or de-celerating sharply?
NO
YES
(DECISION #4) GO TO MORE DIFFICULT SKILL OR GIVE BETTER CONSEQUENCES.
BASIC COMPLIANCE PROBLEM
BASIC ACQUISITION PROBLEM
(DECISION #6) PROVIDE BETTER INFORMATION OR CUES ON HOW TO PERFORM SKILL
YES
NO
Is trend in correct rate up or flat for last 6 days?
NO
YES
Did correct rates reach 20/min w/errors at 10/min or less?
YES
(DECISION #5) PROVIDE BETTER CONSEQUENCES FOR CONTINUED WORK & PROGRESS
FLUENCY-BUILDING PROBLEM
Did correct rates exceed errors during this phase?
YES
(DECISION #7) PROVIDE BETTER FEEDBACK ON DIFFERENCE BETWEEN C & E
BASIC FORMAT PROBLEM

Figure 7
Decision Rules for Low-Rate Behaviors


START
Has the pupil met the performance aim for the project?
YES
PROGRAM WAS SUCCESSFUL
(DECISION #1) MOVE TO THE NEXT STEP IN THE PROGRAM OR ANOTHER SKILL
NO
Are three corr. rates in a row below the min'cel line?
YES
NO
Is correct rate trend flat or going down for 6 days?
YES
NO
(DECISION #2) DO NOT MAKE ANY CHANGES IN THE PROGRAM AT THIS TIME.
PROGRAM IS WORKING
Are correct rates for last 5 days all at zero?
NO
YES
(DECISION #3) STEP BACK TO A SIMPLER OR LESS COMPLEX SKILL LEVEL.
INCORRECT INSTRUCTIONAL STEP
Has pupil ever been highly variable in corrects before?
NO
YES
Did correct rate trend accelerate since then?
YES
NO
Is correct rate highly variable or de-celerating sharply?
NO
YES
(DECISION #4) GO TO MORE DIFFICULT SKILL OR GIVE BETTER CONSEQUENCES.
BASIC COMPLIANCE PROBLEM
BASIC ACQUISITION PROBLEM
(DECISION #6) PROVIDE BETTER INFORMATION OR CUES ON HOW TO PERFORM SKILL
YES
NO
Is trend in correct rate up or flat for last 6 days?
NO
YES
Did pupil reach 83% accuracy -- 5 corrects to 1 error?
YES
(DECISION #5) PROVIDE BETTER CONSEQUENCES FOR CONTINUED WORK & PROGRESS
FLUENCY-BUILDING PROBLEM
Did correct rates exceed errors during this phase?
YES
(DECISION #7) PROVIDE BETTER FEEDBACK ON DIFFERENCE BETWEEN C & E
BASIC FORMAT PROBLEM
DECISION RULES FOR LOW-RATE BEHAVIORS

Decision #4: Go to a more difficult skill or give better consequences.

Studies have shown that many of the "noncompliance" problems demonstrated by children are due to simple boredom. Quite possibly, even with the severely handicapped, the child is being asked to do something that is far too elementary or easy to hold his or her interest. If highly variable performance patterns are noted in the child's record, therefore, going to something more challenging might produce good results. The more challenging material could represent a new, higher level in curriculum, or simply an increase in performance standards (e.g., allowing the child only one second to respond, instead of three or four). If it seems inadvisable to change the actual instructional target, then an attempt should be made to find more powerful consequences or reinforcers to make the continued demonstration of the skill more worthwhile to the child.

Decision #5: Provide better consequences for continued work & progress.

As the child moves more into the fluency-building range of skill development, continued practice with the skill is likely to become more boring and tedious. It may be necessary, therefore, to increase the use or power of reinforcers or consequences to make continued learning more worthwhile to the child.

Decision #6: Provide better information or cues on how to perform the skill.

Performance patterns leading to this decision are generally associate ' with cases in which the child is still unsure of exactly how the task is to be performed. Cues, prompts, corrective feedback or enhanced materials should be used to provide the child with more information and guidance. Increased consequation or reinforcement to "make the child pay attention" might also help, but program revisions designed to provide better and more explicit guidance and feedback are likely to work more often.

Decision #7: Provide better feedback on the difference between correct and incorrect behaviors.

Performance patterns leading to this decision indicate, essentially, that the child after correct and incorrect behaviors, so the child is unsure as to any real difference between them. Great care should be taken to make the feedback and consequences for correct and incorrect performances as different and discreet as possible.

Do the Rules Work

Both sets of rules appear to allow relatively precise predictions about the success or failure of various instructional strategies in promoting continued child progress. For example, Sokolove (Note 5) found that tested elements of the first set of rules (Figure 6) predicted general trends in rates of progress in all but 76 cases out of approximately 3300 instructional programs conducted with normal children. With the second set of rules (Figure 7), Haring, Liberty & White (Note 2) demonstrated that some 31 teachers serving the severely handicapped were more than 2.2 times more successful in picking successful remediation strategies when they used the rules than when they did not. Moreover, in the Haring, Liberty & White study, of those teachers who actually tried the rules in their classrooms 93% found the rules valuable enough to continue using them after the study had ended and they no longer received any special encouragement or support from the project staff. In other words, with the use of rules such as those described above, it seems possible for teachers to move beyond the stage of simply documenting how well a child is progressing and to begin making the types of evaluative decsions which will help to improve that progress. In the truest sense of the word, that is indeed what educational evaluation is all about.

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